

SCIENCE.

FRIDAY, APRIL 4, 1884.

COMMENT AND CRITICISM.

Two bills are before Congress for the better administration of the naval observatory. One places the control of the observatory in the hands of a board, under the secretary of the navy, consisting of the superintendent, the senior line officer attached to the observatory, and the four senior professors of mathematics actually engaged in astronomical work at the observatory: the other is intended to give the positions of assistant astronomers that attraction in the way of promise of promotion necessary to induce young men to enter on the work, looking upon it as a permanency, and not as a make-shift till something better may turn up. It appears that in the past twenty-two years, from the corps of three assistant astronomers, there have been eleven resignations and only four promotions, and of the latter only one in the last nineteen years. It would seem that these bills are both in the direction of placing the working of the observatory on a more permanent footing, and of making it less subject to interruption from changes in the corps of observers, as well as a step towards giving the direction of the scientific work of the institution into the hands of those capable of making it tell better than in the past.

A RECENT statistical inquiry into the working of the system of German universities during the last half-century, is a model of painstaking research and accuracy. The author is Dr. I. Conrad of Halle, well known as a professor of political science; and the volume before us is the fifteenth paper in a series of studies produced, under his direction, by the seminary at Halle, of which he is the director. We might almost as well endeavor to cull interesting facts from a volume

of the census as to draw from these pages, crowded with statistical tables, and illustrated by numerous diagrams, examples of the important and curious lessons brought out by this study. One fact, however, is so patent, and is such an index of the social condition of Germany, that it is worth mentioning. During the last thirty years the attendance on the seven universities of old Prussia has enormously increased, and especially since 1874, when there was a brief temporary retrograde. All the faculties, except that of Roman-catholic theology, show this increase; but that of philosophy has gained far the most, as might indeed be surmised from the growth of modern departments of scientific instruction. In all the universities of Germany, similar progress may be seen. In the decade prior to 1850 (the period of 1848) there was a diminution in the aggregate attendance; in the next two decades there was a slight increase: but since 1870 the number of students has rapidly augmented. Philosophy has gained most, law next, medicine next, and then protestant theology. Catholic theology alone has less followers in these institutions than it had twenty years ago. A summary carefully prepared, of these two hundred and fifty pages, would make an excellent contribution to an American journal of education. A kindred study of the attendance upon American colleges, such as Dr. Barnard of Columbia college initiated a few years ago, would make an admirable basis for the inquiries now in progress as to possible improvements in our institutions of learning. Is there not some agency in this country by which this investigation may be promoted?

THERE has not yet appeared any good and trustworthy illustration of a tornado at work, in spite of the comparatively common occurrence of these storms within sight of many observers. This is natural enough, to be sure; for in addition to the difficulty of the subject,

as may be inferred from the generally poor representation of clouds in woodcuts and other illustrations, there must be quite enough besides sketching to occupy one's mind while a tornado is sweeping past. But now that Mr. Finley has shown that a tornado will almost certainly be harmless when seen in the south-east, is it too much to hope that some well-trained, artistic, and self-possessed observer may secure drawings of the swinging funnel-cloud in its several phases, from which finished and characteristic illustrations can be made at leisure afterwards? A house or tree of known height, and at known distance, would give a unit of angular measure from which the altitude and diameter of the funnel could be determined after the distance to the ordinarily well-marked track is discovered. We should be indeed very glad, if the coming summer were to pass by without visits from tornadoes; but if they come, as is most likely, let as much be found out about them as possible. Water-spouts are in the same need of good portraiture, and an observant voyager in equatorial seas can do good service by bringing home accurate pictures of them. Is there not here a good opportunity for the numerous amateur photographers to turn their experimentation to good purpose? A series of instantaneous photographs would be especially interesting?

A NEW motor is said to have been brought out in New-York City, that hot-bed of schemes for making money out of the unwary. It is a new form of bisulphide-of-carbon engine, this time, which is to revolutionize the world, and the stock of which is offered for sale, to the fortunate who are admitted to the 'ground-floor,' at prices enormously below its real value, giving an opportunity to those favored ones to make the 'millions' that are undoubtedly in it. We are told of a triple thermic motor which is operated by the odorous fluid, and which is expected by the enthusiastic believers in the wonderful invention to give "three times as much power from a steam-boiler used to evaporate the vapor as could be obtained from the same boiler by means of a

steam-engine." It is said that large sums have been paid for the stock of the new company operating this machine by the ignorant capitalist, who, sharp as he is when 'working his points' in Wall Street, — not having even the intelligence of the man who acted as his own lawyer, and seldom thinking of consulting an engineer of known integrity and good professional standing, in a matter which demands at least the rudiments of an ordinary scientific training, — is often gulled with startling ease by the venders of 'Keeley motors,' and promoters of similar schemes.

THE hydrographic office of our navy department has lately issued the first numbers of a set of monthly meteorological charts of the North Atlantic, containing the results of many thousand observations on the winds and other atmospheric phenomena in form for giving practical information to the navigator. These are not to be confounded with the monthly pilot-charts begun in December last, of which mention has already been made in our columns, but are vastly more thorough. Indeed, the two series have about the relation to each other that weather has to climate. One is designed chiefly to spread information concerning recent changes in lights, buoys, etc., and to gather and record temporary conditions of the ocean: the other aims to give in detail the average and consequently permanent elements of maritime meteorology for every five degrees square of the ocean and for every month. The charts now published are for March, April, and May: the rest of the set will probably follow in the course of the year. Every one interested in the growth of our mercantile marine, as well as in the improvement of our navy, must rejoice to see this action of the hydrographic office toward the maintenance of the wide reputation for meteorological work on the ocean, well earned in Lieut. Maury's time; and we trust that the series of charts now begun for the North Atlantic may be followed by others of equal detail for the other oceans, towards which a great amount of available material has been accumulated.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The great comet of September, 1882.

A MORE recent determination of the orbit of this comet than those mentioned in No. 57 of *Science* has been made, and the results may be of interest. To avoid (as far as may be) the errors which arise from the fact that different observers have observed various portions of the nucleus, it was thought best to take a series of observations made at a single observatory. A fine series of over one hundred observations made at Cordoba, and extending from Oct. 17, 1882, to June 1, 1883, was chosen. Up to Feb. 12, the same portion of the nucleus was observed: this portion afterwards became invisible, and then the estimated centre of the elongated nebulous mass was taken.

By comparing these observations with an ephemeris computed from a former orbit, three normal places were found, the four observations made in May and June being neglected. The dates of these normal places were Nov. 16.0, Jan. 3.0, and March 25.0. It is to be regretted that these observations did not begin in September, so that the first normal place might have been nearer the time of perihelion. Below is the derived system of elements, which is referred to the mean equinox of 1883.0, Greenwich M.T.

T	Sept. 17.2637
π	55° 2' 16.59"
Ω	345 43 55.01
i	141 54 31.54
ϕ	89 13 55.8
$\log e$	9.9999610
$\log q$	7.8821773
$\log a$	1.9289
Period	782.4 years.
Perihelion distance	707,500 miles.
Semi-major axis	7,878,000,000 "
Semi-minor axis	105,600,000 "

These elements satisfy the second normal place very closely, the residuals being—

$$\Delta \lambda \cos \beta = + 0.02''; \Delta \beta = + 0.02''.$$

If the period be assumed as 751 years, on the assumption that the comet appeared in 370 B.C. and 1132 A.D., and the foregoing perihelion distance be accepted, the logarithm of the eccentricity must be 9.9999599, which is 0.0000011 less than the value given above.

It is the intention of the writer to combine all the reliable observations which have been made, in the hope of obtaining a fair orbit for this perplexing object.

H. A. HOWE.

University of Denver,
March 11.

Atmospheric wave from Krakatoa.

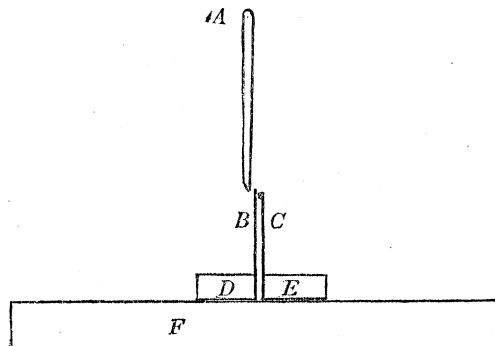
Granting, as stated in *Science*, iii. 338, that an atmospheric wave passing over the entire world was caused by the great eruption in the Straits of Sunda, would not its greatest effect be observable at the opposite extremity of the diameter of the earth, or near the northern extremity of South America? The wave would doubtless pass away from its origin in all conceivable directions, its front forming the arc of a small circle, constantly enlarging until it became a great circle, after which it would contract, converging as to a focus on the opposite side of the earth, producing a magnified effect; after which it would return as from a second origin.

W.

Hoboken, March 16.

Electric time-signals.

The devices, recently described in *Science*, by which a clock is made to close an electric circuit at regular intervals, prompt me to describe a very simple one which I have found entirely satisfactory. It is applied to a tower-clock as follows: to the arbor carrying the minute-hand, at the end *A*, opposite the dial, is screwed a slender brass arm about five inches in length, extending down to two light metallic springs, *B C*. The brass arm at the proper moment comes in contact with *B*, and moves it forward till it touches



the platinum point on *C*. The electric circuit is then closed, as *B* and *C* are soldered to two brass blocks, *D E*, to which the wires of the circuit are attached. These blocks are screwed fast to a piece of wood, *F*, which is in turn secured to the clock-frame by set screws. It will be observed that the current does not pass through the works of the clock. The appliance can be made to close the circuit at any portion of the hour by simply loosening the movable hand at *A*, and fastening it so that it shall bring the two springs together at the required minute. This arrangement has not failed once in a year and a half on a circuit including nine bells.

H. S. CARHART.

Evanston, Ill., March 17.

Is material contact possible?

Dr. John Robison, the eminent Scottish physicist, discussing 'Newton's rings' (about 1795), concluded that to produce the central 'black spot' between two glasses required a pressure of about a thousand pounds to a square inch; the separation at this place being still about $\frac{1}{250000}$ of an inch. Dr. Thomas Young (about 1805) found that the phenomenon does not depend on the presence of air. By the general consensus of physicists this has been accepted as a striking evidence that molecular resistance to absolute contact is insuperable.

Sir William Thomson, in a Friday evening lecture at the Royal Institution of Great Britain, delivered Feb. 2, 1883, said, however, very emphatically, "I do not believe that for a moment. The seeming repulsion comes from shreds or particles of dust between them" (*Proc. Roy. Inst.*, Feb. 2, 1883, *x*. 189; *Nature*, June 28, 1883).

As a question of fact, this is one of very great importance; and it surely deserves a critical and decisive determination by some of our well-equipped physicists. The investigation, though a very delicate and refined one, is quite within the resources of modern experimentation. The physical problem is, can the 'black spot' between perfectly clean plates be produced without sensible pressure?

W. B. T.

High tides in geological history.

In the review of the *Geographisches Jahrbuch* for 1882, published in *Science*, No. 54, the notice of the contribution of Dr. Zöppritz on the progress of terrestrial physics contains the following words:—

"In commenting on Professor George Darwin's work on the effect of the tides upon the moon's distance, and on Mr. Ball's entertaining lecture, 'A glimpse through the corridors of time,' on the same subject, the reviewer accepts Professor Newberry's conclusion, that the moon must have already attained its actual distance from us when our oldest Cambrian and Silurian strata were deposited. This seems an unnecessary adherence to doctrines of uniformity: for, in the spread of our paleozoic strata, there is evidence of much stronger submarine transportation than we now find; and even in Jurassic times there is a surprising area of cross-bedded sandstones in the region of the Colorado plateau."

Those who have followed the discussion in *Nature*, of the theory of ancient high tides proposed by Professor Ball as a lesson to geologists, will perhaps remember that I declined to receive the lesson, and denied the existence of the imagined high tides, because the geological record not only contains no traces of such tides, but, on the contrary, supplies abundant evidence that no such violent action accompanied the formation of the sedimentary rocks. In making this statement I was not constrained by any devotion to uniformitarianism, as the reviewer intimates, but based my conclusions upon an unbroken series of *facts*. These facts prove that the accumulation of the paleozoic rocks took place in conditions essentially like those which prevail at present, and show conclusively that the statement, "that in the spread of our paleozoic strata there is evidence of much stronger submarine transportation than we now find," is unwarranted. As that statement and those I have made are in direct conflict, and the question involved is an all-important one in the reading of geological history, I take the liberty of reviewing briefly the evidence on which my conclusions were based.

In the Cambrian age were laid down, along the eastern margins of our continent, the Acadian shales of New Brunswick, the Olenellus shales of Vermont, the shales and limestones of Troy, and the shales (now siliceous slates) of Braintree, Mass.,—all the products of quiet deposition. In the Mississippi valley the Cambrian strata are buried, and inaccessible to us. In the Lake Superior region the copper series was probably deposited in the Cambrian age, although demonstration of this has not been obtained. There volcanic disturbances and eruptions produced great activity in the agents which form mechanical sediments,—conglomerates, sandstones, and shales; but this violence was all local, as we find no traces of it outside that area. In the far west the Cambrian rocks are well exposed in many places, and constitute twelve thousand feet of shales, with one stratum of limestone in the section of the Colorado Cañon, seven thousand feet in Nevada, and twelve thousand feet in the Wasatch, of sandstones, shales, and limestones, according as deposited under inshore, offshore, or open-sea conditions, but nowhere showing marks of more violent action than may be observed to-day.

In the lower Silurian rocks we have the record of a great continental subsidence, or elevation of the ocean-level; the advance of the sea upon the land; and the spread of a sheet of sea-beach material—the Potsdam sandstone—as far as the invasion extended. But the Potsdam beach was precisely like the beaches of to-day,—ripple-marked, sun-cracked, bored by annelids, strewn with seaweeds, and abounding in the entire or broken shells of beach-inhabiting brachiopods. Above this we have the organic deposits made

by the Silurian sea when it stood over the submerged territory,—a thousand feet or more of limestones. Then the Hudson River and Utica shales were laid down in the shallower waters of the retreating sea. Here we have a complete history of the physical conditions which prevailed during the formation of the lower Silurian rocks, but nowhere find any traces of the high tides of Professor Ball's interesting but imaginative lecture.

A similar round of deposits composed the upper Silurian, the Devonian, and the carboniferous systems. Each group of rocks tells its own story so clearly that a child may comprehend it; and that story is not only without any high-tide episode, but is clearly and positively contradictory to the high-tide theory.

Your reviewer cites no facts to sustain his statement, and there are none. The cross-bedded mesozoic sandstones of the Colorado plateau have, of course, no bearing upon it, and they afford no support to the high-tide theory: they simply show that peculiar conditions prevailed in the triassic age over a limited area on the east side of the Wasatch, where a shallow sea was moved with strong currents, tidal or otherwise. On the west side of the land which separated this ancient Bay of Fundy from the Pacific, the triassic and Jurassic strata show no such violent action; and the same may be said of other parts of the world. The records of the cretaceous age, which are the most complete and completely exposed to view of any, are the most conclusive in their demonstration of the absence of violent and abnormal action in the processes of nature.

I may also call the attention of your reviewer to the fact that Prof. G. H. Darwin, whose study of the physical structure and history of the system of Mars was the inspiration of Professor Ball's lecture, declines to subscribe to his conclusions, and concedes that there is no evidence of abnormally high tides since the beginning of the paleozoic ages.

J. S. NEWBERRY.

The flora of Labrador.

A contributor to No. 59 tells us that "I have endeavored to show that we must look to the north for the place of origin of many of our plants," and that he "can see further reason for the assertion" in an analysis which he makes of a very incomplete list of the flora of Labrador. He further teaches us,—

"That many of these plants were at one time distributed all around the Arctic circle, there can be no doubt; and that they have been driven from their first homes by the excessive cold, and found suitable abiding-places at the south, must also be considered as an established fact."

Now, Mr. Editor, is not all this so well established and so familiar as to render superfluous the *endeavor to show it* in the form of a contribution to *Science*? Whatever may be said upon the question 'where did life begin?' considered deductively, there is no longer any doubt as to where the vegetable life around us came from; nor does your contributor throw any new light upon the matter, in the column which he fills.

BOTANICUS.

How do the winds blow within the storm-disk?

The following method of showing graphically and concisely the result of many observations on storm-winds may, on account of its simplicity, prove of value to students of meteorology. Synchronous observations of winds charted on weather-maps for any single epoch are generally too few and often too discordant to give a precise picture of the spiral course followed by the whirling air; and it is difficult to combine by

eye-memory the observations plotted on several separate charts. But this combination can be made easily

the circle of three hundred mile radius, where the longest arrows represent hurricane violence, or twelve of the Beaufort scale; and, second, that these winds have, with notably few exceptions, a distinct departure from a circular path to an incurving spiral. Very evidently, therefore, the centre of this storm would not bear 'about eight points' to the left of the wind's course, as the older mariner's guides put it, but generally about six, or in some cases even as little as four, points to the left, as has been shown in many other examples.

Fig. 2 shows the result of similar treatment of several days' records of storm-winds in our northern states, as mapped in the Signal-service daily bulletins for October, 1877. Observations north of the centre are unfortunately rare, as we have not as yet sufficient stations in the British possessions. Although the three hundred arrows show numerous discordant directions, the general motion indicated by them is again clearly an incurving spiral.

This method of concentrating observations on a single diagram may prove of service in several directions of storm-study, being applicable to the determination of the general form of isobars, and areas of cloud and rain, as well as to the investigation of the inclination and velocity of the wind in different quadrants of the storm, or at stations of different situation as to distance from

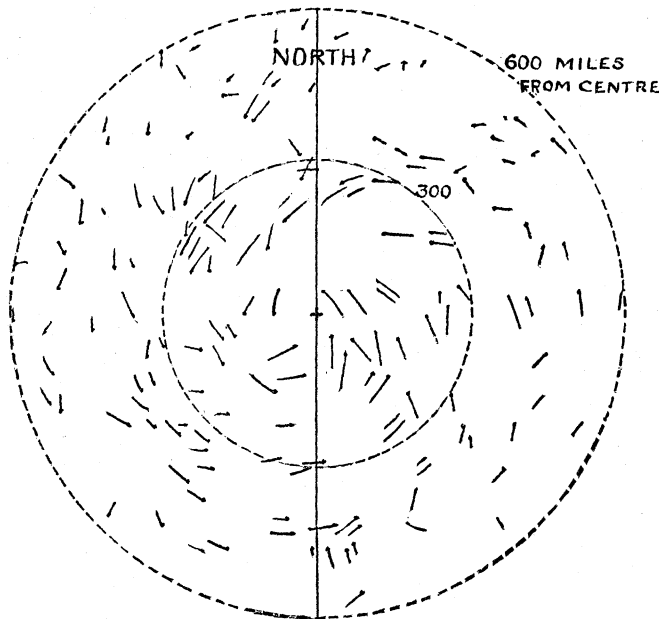


FIG. 1.

and accurately by taking off the records of successive dates on a single sheet of tracing-paper. A cross on the paper marks the storm-centre, always to be placed on the middle of the area of low pressure; and a north line, laid parallel to the meridians, serves as a means of orientation. A large number of observations may thus be transferred to a single figure, and every one of them falls in its proper position with respect to the centre of the storm.

The synchronous charts of the North Atlantic for August, 1873, prepared by Capt. Toynbee of the British meteorological office, yield a hundred and fifty-seven wind-records within six hundred miles of the centre of a cyclone that passed from the West Indies along our coast in the ten days from the 18th to the 27th of that month. These are all brought into the accompanying diagram (fig. 1), which shows very clearly, first, that the stronger winds are nearly all inside

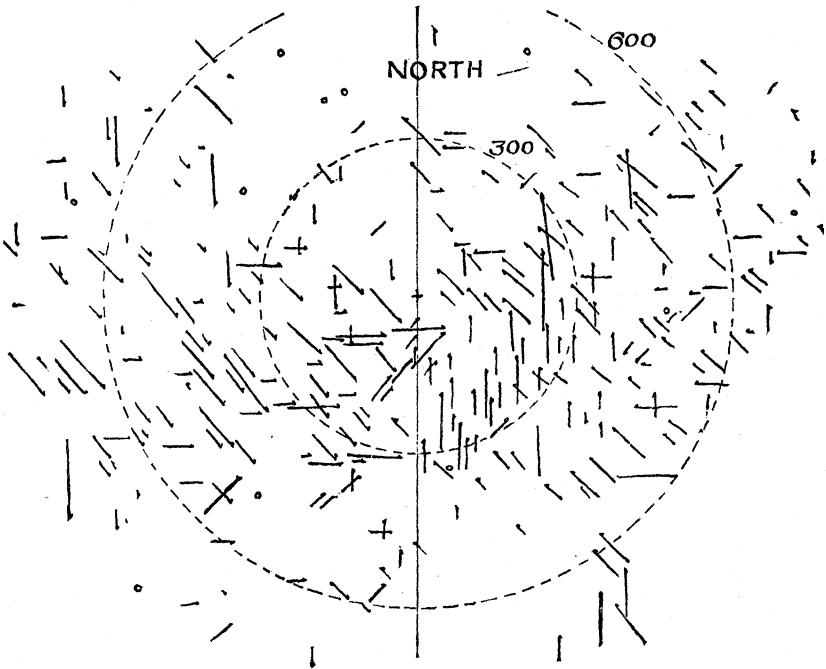


FIG. 2.

the coast-line, or elevation above sea-level.

Cambridge, Mass.

W. M. DAVIS.

Undulations in clay deposits.

A ditch about two feet deep, and running nearly east and west, on the grounds of this college, presents a profile as if the clay (which is of unknown depth) had been shaped into undulations, with crests from eight to fifteen feet apart, and then covered unconformably by the sandy soil, which over the crests is about two or three inches deep, and in the troughs about two feet at most. The 'strike' of the crests is nearly north and south. This peculiar formation has been observed over a large area of country in this vicinity. A surface peculiarity is the occurrence, at intervals of one or two hundred yards on the prairies, of low mounds a foot or two high, usually covered with dewberry briars. West of this place, in Milam and Williamson counties, the nearly level prairies are mammillary, with slight elevations eight or ten feet apart, presenting the appearance of old tobacco or potato hills on a gigantic scale. These appearances, visible from the cars, excite the curiosity of all who observe them; and a plausible theory of their cause might not only gratify this, but lead to some very important discoveries in dynamical geology. For these reasons I desire to present this problem to your geological readers; and, if it has already been solved, my apology for ignorance of the solution must be that I am not a geologist.

H. H. D.

Agricultural and mechanical college of Texas,
College Station.

'A singular optical phenomenon.'

Having made the phenomena of binocular vision a special study for many years, I was greatly interested in the letter of 'F. J. S.' in *Science*, No. 57. But I confess I do not quite understand it. I can but think that the phenomenon he describes is only an example of 'phantom image,' produced by binocular combination of similar figures of a regular patterned field—in this case, the squares of the coarse screen. But in that case the image ought not to be inverted nor enlarged. As to the inversion: if, as I suppose, your correspondent imagines it inverted only because it moves with the head, he is probably mistaken. There is no optical law by which an inverted image could be formed under the conditions described. The movement of the image is simple parallax motion. The point of sight being the centre of parallax rotation, if the image be nearer than the object, the motion will be in the same direction as that of the head of the observer; but, if the image be farther off than the object (a far more difficult case), the motion of the image will be opposite that of the head.

There still remains, however, the enlargement of the image. This is incomprehensible to me. It ought to be diminished in exact proportion to its nearer distance. Neither can I at all understand what is said about the phenomenon as seen by a near-sighted person. I should be glad if your correspondent would repeat and describe more accurately the phenomenon; for there are no phenomena more illusive, and requiring more practice to understand, than those of binocular vision. If I am right as to the nature of the image, it ought not to be seen with *one eye only*.

The subject of phantom images is fully explained in my little volume on 'Sight,' pp. 107-119.

JOSEPH LECONTE.

Berkeley, Cal., March 18, 1884.

The possible origin of some osar.

The writer does not profess to have an extensive acquaintance with these problematic structures; but,

a few examples having been discovered in his researches in Dakota, the subject of their origin has been thrust upon him.

From several considerations, which need not be given here, it seems extremely improbable that the quaternary glaciers in that region bore, either on their surface or in their depths, any considerable amount of *débris*, at least nothing coarser than dust upon their surface, and perhaps gravel in their lower portions. How, then, can steep meandering ridges nearly continuous for miles, ten to thirty feet in height, running nearly at right angles with a great moraine, and much more stony than the surrounding surface and the general mass of the till, be explained?

The following hypothesis is offered for criticism. Given a sub-glacial stream, or a super-glacial one, which, near the edge of the ice-sheet, has cut an ice-canyon through to the ground moraine: the presence of the ice-cliffs on either side would tend to force a plastic body like the till toward the stream, and cause it to rise underneath the stream, like the 'creeps' frequently occurring in coal-mines or deep cañons. Now, if the streams have only a velocity sufficient to wash out and carry off the finer material, the bowlders and gravel will be left in excess, and in ridges along the line of the stream. Of course, stratified beds of sand and gravel would form a considerable portion of hills produced in this way, just as in the case of those formed according to the usually accepted theories. Similar breaks and lateral repetitions of the ridges might result according to either of the theories.

It seems, moreover, not improbable that some of the re-entrant spurs of terminal moraines may have begun in this way; the cañon developing into a notch, and giving rise to lateral flowage of the ice, as well as increasing of the till.

J. E. TODD.

Tabor, Io.

Osteology of the cormorant.

In late numbers of *Science*, several communications have appeared from Dr. Shufeldt (ii. 640, 822; iii. 143) and Mr. Jeffries (ii. 739; iii. 59) on the 'osteology of the cormorant,' and especially on so-called 'occipital style;' and complaint is made by Mr. Jeffries (iii. 59) that Dr. Shufeldt 'does not mention the nature of the bone' in question. Neither gentleman seems to have been thoroughly acquainted with the literature of the subject; and inasmuch as both are members of a committee of the American ornithologists' union, appointed to investigate the anatomy and physiology of the birds, they may be thankful for a reference to a special paper on the anatomy and functions of the bone in dispute. It is to a memoir by William Yarrell that I refer. Yarrell designated the 'occipital style' of Shufeldt as the 'xiphoid bone,' and in 1828 communicated to *The zoological journal* an article (iv. 234-237, art. xxviii.) 'on the use of the xiphoid bone and its muscles in the corvorant (*Pelecanus carbo* Linn.),' which is accompanied by two figures on plate vii. (figs. 5 and 6) illustrating the skull, with the xiphoid bone, and the muscles in relation with it and the lower jaw. The development of the peculiar bone is correlated with the weakness of the lower jaw; but for further information those interested must refer to *The zoological journal*, where they will likewise find references to the views of other authors.

Lest *Science* or myself should be charged with making or overlooking a typographical error, I beg to add that 'corvorant' is the substitute for cormorant, adopted by Yarrell, probably from a false or confused idea as to the etymology and history of the word.

THEO. GILL.

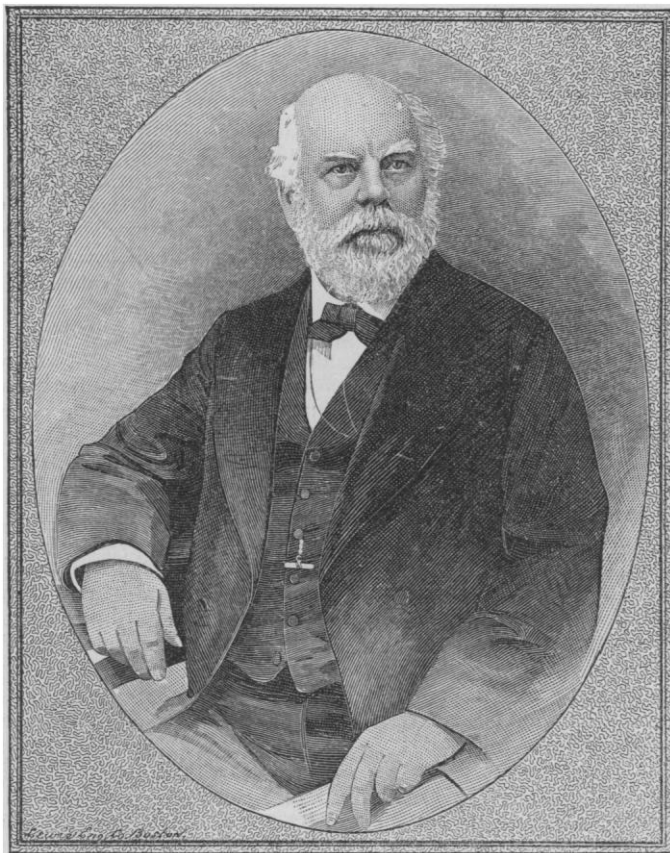
GEORGE ENGELMANN.

GEORGE ENGELMANN was born in Frankfort-on-the-Main on the 2d of February, 1809. He died in St. Louis just after the completion of his seventy-fifth year, on the 4th of February, 1884, very unexpectedly, and after an illness which had kept him from his scientific work but a few days.¹

Dr. Engelmann received his medical education and early scientific training at Berlin, Heidelberg, and Frankfort. Agassiz, Alexander Braun, and Charles Schimper were among his college-associates and lifelong friends. His determination to establish himself in the United States must have been made early; for he left Germany almost at once after graduation, reaching New York in 1832. His first visit was to Philadelphia, attracted there by the scientific reputation of that city, where he was fortunate enough to make the acquaintance of Nuttall and other scientific men. His inclinations, however, still turned westward; and young Engelmann soon left the seaboard, to seek a home in the almost unexplored regions beyond the Mississippi. He went first to St. Louis, then scarcely more than a frontier trad-

ing-post, influenced, no doubt, in this step by the fact that there was already a little colony of Germans located there. But Dr. Engelmann did not at once establish himself in St. Louis. With the deliberation and care which characterized all the actions and studies of his life, he determined to see something of the western country before finally selecting a home. For

this purpose he undertook a long and solitary journey on horse-back through southwestern Missouri, Arkansas, and western Louisiana. This journey was probably made in 1833, and occupied six months. It nearly cost Dr. Engelmann his life; for the young traveler took a dangerous fever among the Arkansas swamps, into which his botanical zeal, no doubt, often led him. Fortunately he fell into the hands of a negro family, who nursed him faithfully through his long illness, which cut short further exploration, and hurried him back to St. Louis.



G. Engelmann

Here Dr. Engelmann finally established himself as a physician in 1835. He had previously, however, gone to Germany, and on his return had brought back with him, to his new home, the faithful and devoted companion who shared his labors, his trials and triumphs, for more than forty years. From 1835 until his death Dr. Engelmann continued to live in St. Louis, and to devote to scientific investigations every moment which could be spared from a large

¹ The announcement which appeared in a previous number of this journal, that Dr. Engelmann died on the 11th of February, was erroneous: he died on the 4th of February.

and absorbing professional practice. He was able, however, to make, at long intervals, several visits to Europe (the last as recently as last year) largely for the purpose of botanical study; although his opportunities for extended botanical explorations in his adopted land only came to him late. Twice in the last ten years of his life Dr. Engelmann was able to see Colorado; in 1876, he visited the southern Alleghany Mountains; and in 1880 made a long journey through the forests of the Pacific states, where he saw for the first time, in a state of nature, plants he had studied and described more than thirty years before. Dr. Engelmann's associates in this long and arduous journey will never forget his courage and industry, his enthusiasm and zeal, his abounding good nature, and his kindness and consideration of them and every one with whom he came in contact.

Engelmann's first botanical publication appeared as long ago as 1832, when, on the eve of his departure for the United States, he printed in Latin a *dissertatio inauguralis*, 'De Antholysi prodromus,' illustrated by drawings made by the author. This paper is still sometimes referred to, and was certainly a remarkable production, in view of the youth of the writer, and the existing knowledge of vegetable morphology. No other botanical paper appeared from Dr. Engelmann's pen until 1842, when he published in the *American journal of science* his monograph of North-American Cuscutineae. He had, however, some time before, in association with Capt. C. Neyfeld, undertaken the editorship of *Das westland*, a journal printed in Heidelberg, and intended to make known to German emigrants the advantages of the Mississippi valley. This publication did not outlive the first volume, which bears upon the titlepage the date of 1837, and which contains three articles by Engelmann, generally descriptive of the natural features of the western country, with some account of his southern journey of 1833. If these early years in St. Louis were not prolific in botanical publication, their botanical occupations were not the less important and valuable. He made, at the time, large collections of western plants, then hardly, if at all, represented in European herbaria, distributing them freely among his German correspondents. At this time, too, he made the acquaintance of the authors of the 'Flora of North America,' to whom Engelmann first became known through the discoveries, by the younger of the two botanical partners in this undertaking, of some of his specimens in the Berlin herbarium. This rather roundabout

introduction led to a warm friendship and close and sympathetic scientific association, which has largely shaped the botanical studies over a great continent, and which death only has interrupted.

The appearance of the monograph on Cuscutineae, which was soon republished in the *Botanische zeitung* and the *London journal of botany*, established Engelmann's reputation as a systematic botanist, and procured for him the correspondence of Hooker and other foreign botanists. Several new species are described in this paper, and the genus *Lepidanche* proposed for a Cuscuta-like plant of the western prairies. Cuscuta always interested Dr. Engelmann; and in 1859 he published in the Transactions of the St. Louis academy an elaborate revision of the whole genus, for which he had long been collecting material.

In 1842 he published in the *American journal of science* a list of plants collected by Charles A. Geyer in Illinois and Missouri, in which several species are first described; and in 1845, in the *Journal of the Boston society of natural history*, in collaboration with Asa Gray, an enumeration of plants collected in western Texas by his countryman, Ferdinand Lindheimer, a naturalist attached to the German colony of New Braunfels.

In 1848 was published his sketch of the botany of Dr. A. Wislizenus' expedition. Dr. Wislizenus, a German physician and a resident of St. Louis, had been attached to Col. Doniphan's expedition, but was taken prisoner by the Mexicans, and carried to Chihuahua, where, as well as in the valley of the Rio Grande, he had made important botanical collections. These were afterwards placed in Dr. Engelmann's hands for elaboration. The study of these collections exerted a powerful influence upon his subsequent botanical studies. They first drew his attention to Cactaceae and Pinus, which continued to occupy his thoughts for the remainder of his life, and of which his knowledge was unequalled. As early as 1856, Dr. Engelmann published in the Proceedings of the American academy a synopsis of the Cactaceae of the territory of the United States. Two years later appeared his 'Cactaceae of the boundary,' in the second volume of the United States and Mexican boundary survey report. This paper, superbly illustrated by drawings made (under Dr. Engelmann's direction) by Roethe, is, perhaps, his best-known botanical work. Dr. Engelmann has studied and described all the collections of Cactaceae which have from time to time been made in the Mexican boundary region, and, had he lived,

would have elaborated the whole order in accordance with his latest views of the subject. He even proposed so late as last year to pass a considerable time in northern Mexico for the purpose of studying these plants in their native country before finally giving to the world the final results of his long investigations. That he did not live long enough to elaborate the mass of material he had so industriously collected for this work is an irreparable loss to botanical science; for no other hand, in this generation at least, will be able to take up this family where he has left it.

Other difficult genera have long been studied by Dr. Engelmann. His predilections, indeed, have always been for the most difficult and perplexing plants; and he willingly devoted himself to such genera only as less patient investigators hesitated to take up. Thus he mastered the North-American Euphorbiaceae, elaborating all recent collections of the family, without, however, undertaking a complete revision of the order as represented in this country. He published an elaborate and exhaustive paper upon the North-American species of *Juncus*, and, later, one on the North-American Isoetes. His published notes upon the North-American species of *Quercus*, for years one of his most engrossing subjects, and upon North-American *Abies*, *Juniperus*, of the section *Sabina*, and upon the genus *Pinus*, contain the most valuable and trustworthy information which has appeared upon these plants. In 1873 Dr. Engelmann published, under the title of 'Notes on the genus *Yucca*,' his elaborate revision of the genus here first comprehensively treated. Two years later his notes on *Agave* appeared, in which are enumerated and described the species detected within the limits of the United States, as well as a few foreign species previously imperfectly known. Dr. Engelmann studied for many years the genus *Vitis*; and our knowledge of the North-American species is due in a large measure to his investigations. His last botanical publication, a sketch of the true grapevines of the United States, although written some months earlier, and previous to his last European journey, was issued late in 1883.

Dr. Engelmann's botanical writings were not voluminous. All his work, however, is characterized by the most careful and conscientious preparation, great good judgment, classical methods of treatment, and remarkable thoroughness. His investigations were slow and laborious, often lasting for years in the case of a single plant. No botanist was ever less anxious to publish prematurely the results

of his observations, or was less satisfied with the extent of his own knowledge. Such admirable, and in these days unusual, caution has made Dr. Engelmann's botanical writings masterpieces in their way, worthy to stand with the best productions of their nature which have yet appeared. This very caution and desire to wait for completeness, however, which have made Dr. Engelmann's published papers what they are, have cost the world a vast store of valuable information collected by him during long years of careful investigation, but never quite ready, in his critical judgment, for publication.

Dr. Engelmann, in addition to his professional and botanical labors, was a most zealous meteorological observer, and at the time of his death was probably one of the oldest meteorologists in the United States. He published many important papers upon this and various physical and topographical subjects, but the length to which this notice is already extended precludes more than the mere mention of this fact. His meteorological and other miscellaneous papers, as well as his important botanical papers since 1859, have been published in the Transactions of the St. Louis academy of science, which he was largely instrumental in establishing, and which he long served as president.

Dr. Engelmann was a member of the American academy of arts and sciences, a corporate member of the National academy of sciences, a foreign member of the Linnaean society of London, and an active or corresponding member of many other learned bodies. His career was eminently successful. He lived to see the correctness of his judgment in selecting St. Louis as his adopted home confirmed, the frontier trading-post grown into a great city, and himself at the head of his profession there, and then his place occupied and worthily filled by his only son. He long enjoyed the friendship, the respect, and the correspondence of many of the most distinguished botanists of the age, everywhere the recognized authority in those departments of his favorite science which had most interested him.

George Engelmann, it is fair to assume, will long live in his botanical writings. The thoroughness of his work leaves little to subsequent workers in his chosen fields to gather, and secures its permanent usefulness and value. When, however, his written words are forgotten, the western plains of his adopted land will still be bright with the yellow rays of *Engelmannia*; and the splendid spruce, the fairest of them all, which bears the name of Engelmann,

will still, it is to be hoped, cover with noble forests the highest and most inaccessible slopes of the Rocky Mountains, recalling to men, as long as the study of trees occupies their thoughts, the memory of a pure, upright, and laborious life.

THE MAXIMA AND MINIMA TIDE-PREDICTING MACHINE.¹

This machine has been invented by Mr. Ferrel, and constructed by Fauth & Co. of Washington, for the use of the Coast and geodetic survey. Its object is to determine mechanically the times and heights of high and low waters for the numerous tide-stations around our coast, for which tide-tables are annually published. The numerical data for these have been heretofore obtained by computation; but, on account of the great complexity of the tidal theory and formulae, this involves a great amount of labor to obtain even approximate results, and more accurate ones have to be dispensed with, unless they can be obtained in some way mechanically, with much greater facility than by computation.

The first tide-predictor was invented by Sir William Thomson, about eight years ago. This was constructed so as to take into account about ten only of the principal tide-components; all, however, which are of much practical importance. This machine has not been used in the regular prediction of tides, and is said to be now on exhibition at the South Kensington museum.

Subsequently Mr. Roberts, of the *Nautical almanac*, London, had another constructed upon somewhat the same plan, but larger, taking into account twice as many of the components, and having some improvements on the plan introduced. A description of this machine was given in *The engineer* of Oct. 19, 1879. It is now being successfully used in the prediction of the tides of India.

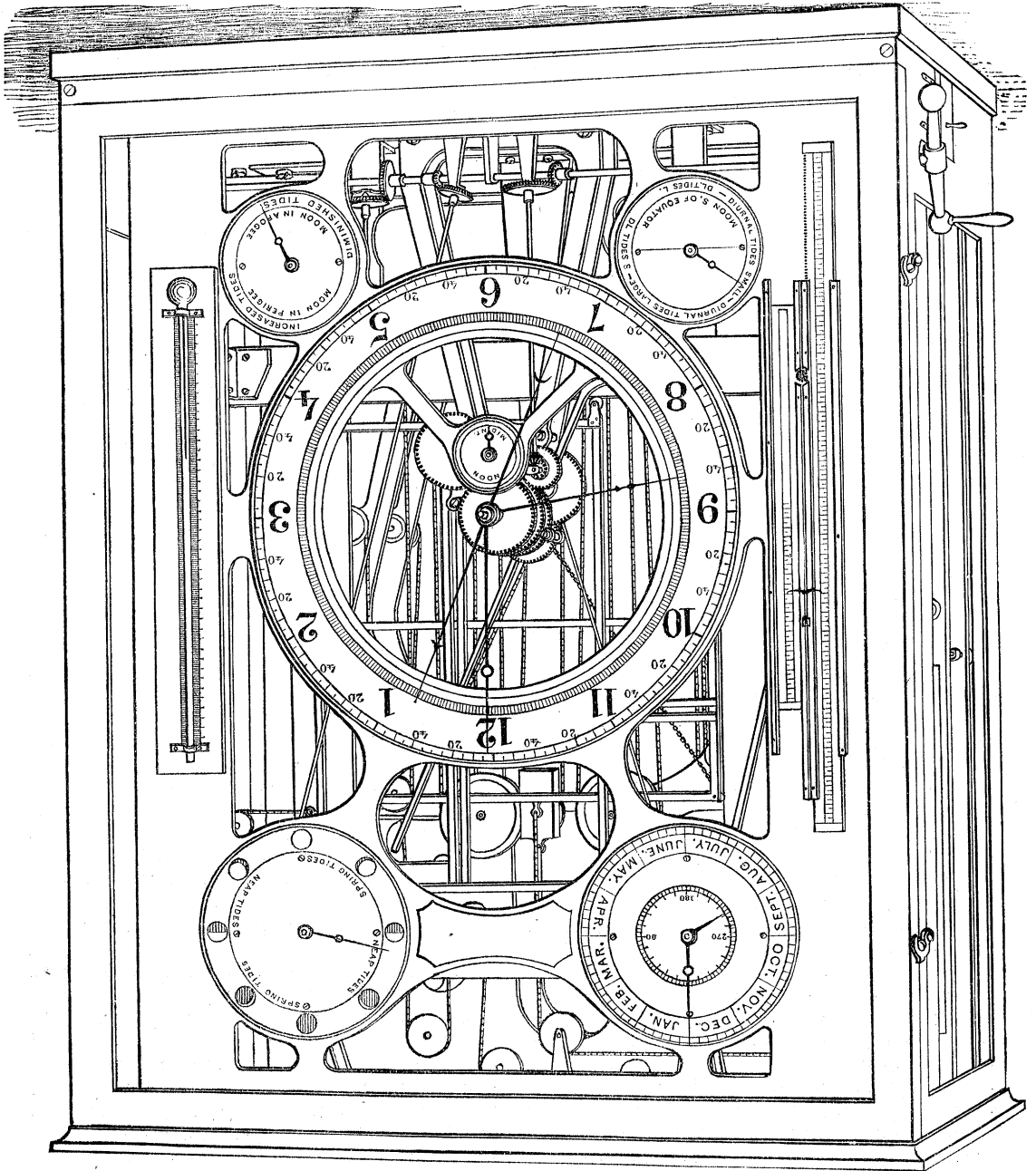
Both of these machines have been constructed so as to be run by clock-work, and to give the results in the form of a tide-curve for one year on a roll of paper, from which the times and heights of high and low waters are afterwards read off and recorded.

In the maxima and minima predictor, only the maxima and minima of the heights of the tide above mean low water or any other assumed plane of reference, and the times of their occurrence, are indicated; as these alone are

required for the tide-tables annually published. For this purpose a transformation of the tidal harmonic function was necessary, so that it would give heights and times of the maxima and minima; and, as any such transformation usually renders the resulting expression much more complex than the original one, the whole theory and construction of this machine is much more complex than in the case in which the machine is required to give the height of the tide at regular stated intervals of time, or a graphic representation of the whole function. In this machine both the clock-work and roll of paper are dispensed with, and the machine is run by means of a small crank at the side, with the left hand; and the times and heights of high and low waters are read off from the face of the instrument, and recorded as you go, with the right hand, upon blank forms ready for the printer. The great advantage which is claimed for this form of the machine is that it gives only what is required, and this in such a way that the results can be recorded at once, and the trouble of handling long rolls of paper, and estimating the times of maxima and minima, and reading off the corresponding height of the tide, is saved. Although the machine is more complex, this makes no difference in the facility with which the results are obtained. The crank is turned until an index on the central dial of the face, called the lunar index, pointing between eight and nine on the accompanying perspective representation of the face of the instrument, comes in conjunction with the upper end of an oscillating needle, the upper end pointing between twelve and one, as represented, when the time of high water is pointed out by another index on the same dial, called the solar index, pointing, as represented, to the figure twelve, at noon and midnight, and the height is indicated by an index on a vertical scale on the left side of the face of the instrument. You then turn until the lunar index comes in conjunction with the lower end of the needle, when the solar index points out the time of low water, and the index at the side, its height. Turning until the lunar index comes in conjunction again with the upper end of the needle, you read off, as before, the times and heights of the next high water; and so on from high to low and from low to high water through the year, recording the results as you go. Where, however, there are large diurnal components, it is necessary to run through twice, — first for the times, and then, after a little change in the setting, for the heights. The machine, therefore, is especially convenient for most of the tides having a large range upon our At-

¹ This article, written by Mr. WILLIAM FERREL, is published by permission of the superintendent of the Coast and geodetic survey.

Atlantic coast, since the diurnal components in these are very small. It would be impossible, in this short sketch, to give any idea of the theory and construction of the machine. These, however, will be contained in an appendix to the report of the superintendent of the U. S. coast and geodetic survey for 1883. The efficiency of the machine is in general very satisfactory. The results given by it have been compared both with computation and observation. In a comparison with one



month's computation of the tides of Boston harbor, the differences in the heights rarely exceeded more than 0.1 of a foot, and in the times more than three or four minutes. These differences arose from a slight yielding of some parts of the machine from a lack of sufficient rigidity. This, however, could be mostly remedied at small expense, if thought necessary, by making some parts of it a little more rigid.

In a comparison of the results given by the machine for three months, of the tides of San Diego, Cal., having very large diurnal components, with the times and heights from observation, the average of the differences, taken without regard to signs, was 0.29 of a foot, and in the times about ten minutes. But these differences are due mostly to meteorological causes, changes in the winds and in the barometric pressure, which cause fluctuations in the mean level of the sea, and are due only in a small measure to imperfections of the machine. These are most conspicuous in cases where the tide-wave becomes very flat from the high or low water of any day being brought very nearly to mean sea-level from the effect of large diurnal components, or where the whole range of the tide is very small; but in such cases the times of maxima and minima are very indefinite, and the error is more in appearance than in reality.

The machine is now being used in the prediction of the tides for the tide-tables of the year 1885, and is in all cases first applied for each station to some year for which there are observations for comparison, and, with the exception of the slight defect referred to, is giving entire satisfaction. The capacity of the machine for doing work is at least that of thirty to forty computers, if these were to take into account every thing which the machine does. In fact, little more time is required than that which is taken up in recording the results.

NOTES ON THE LAVA-FLOW OF 1880-81 FROM MAUNA LOA.

The Hawaiian Islands are entirely of volcanic origin. The various islands appear very distinctly to be of different ages, the volcanic agencies still being continually active in the most south-easterly one, while in those to the north-west they have been extinct for a long period of time.

Hawaii, the largest island, situated at the extreme south-west of the group, has an area of about 4,200 square miles, being about twice the size of the state of Delaware, and not quite

so large as Connecticut. It has four prominent elevations, each of which marks what is or has been a centre of activity. The Kohala Mountains, with an elevation of about five thousand feet, form the northern end of the island: though thickly covered with well preserved crater-cones, their activity ceased before the earliest traditions of the natives. Mauna Kea, the highest peak of the group, with an altitude of 13,825 feet, has also long been extinct. This lies to the south-east of the Kohala Mountains, on the eastern coast. Nearly opposite, on the western coast, is Mauna Hualalai, a little more than 8,000 feet in height. The last recorded eruption from this took place in the year 1801. When visited in the spring of 1882 by J. T. Perryman and J. S. Emerson of the Hawaiian government survey, steam was found to be issuing from several of the fissures on the summit.

South of the preceding three elevations is Mauna Loa, on whose summit, 13,610 feet above the sea, is the active crater of Moku-weoweo. The slopes of Mauna Loa are very gentle, and, when seen from a distance, the whole mountain appears like a gentle swell of land. On its eastern slope, at an elevation of about 4,000 feet, is the famous active crater of Kilauea. This is commonly regarded as a portion of the mountain of Mauna Loa; but it is in reality a separate mountain, though situated so near the other that the lavas from each have flowed together till the outline of this mountain has nearly been merged in that of the other. As seen from the upper portions of Mauna Loa, the individuality of Kilauea is clearly apparent.

During the last hundred years many flows of lava have taken place from both these mountains; all bursting forth from the sides approximately near the summit, but none coming from the crater itself. These have been well described by Rev. Mr. Coan of Hilo, Hawaii, by W. T. Brigham of Boston, and others.

On the 6th of November, 1880, the latest of these flows burst from the north-eastern side of Mauna Loa, at an altitude of about 10,000 feet. From this point it gradually passed down the slope of the mountain, at first toward the north-east; then, making a sharp bend, it flowed for some distance toward the south-east, and then, once more making a sharp bend, took a course directly toward Hilo, a small but pretty village on the eastern coast. The first portion of its course was over a country composed entirely of naked lava above the limits of vegetation. It then entered the belt of forest which skirts the mountain with a

width of seven to ten miles. Through this it slowly ate its way, making a clear, clean path, and finally appeared on the lower side within five miles of Hilo. When within less than two miles of the village, it divided into two branches, one still continuing directly toward the village, and the other taking a course toward the Waiakea sugar-mill, which is about one mile south of Hilo. Finally, in the middle of August, 1881, the flow suddenly

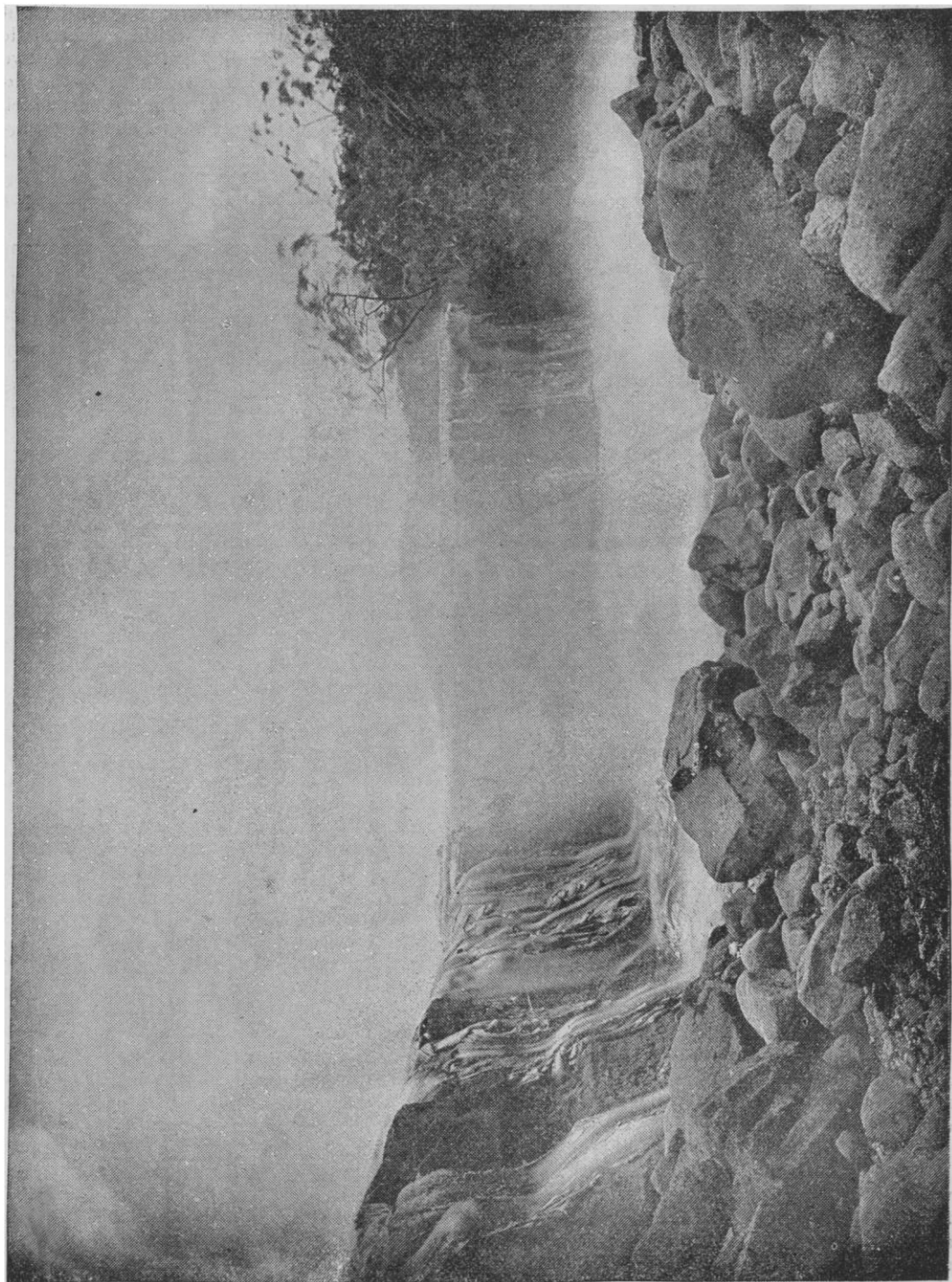
sured in all directions. Some of these were mere cracks, while others were six and eight inches, perhaps more, in width. This made walking over it rather difficult. There are two common forms of lava known there, — the *pa-hoehoe* (satin) and the *a-a*. The former, which is far the more abundant, has much the appearance of folded satin, and usually spreads out in broad, level fields. Sometimes it swells up through some hole in the surface, and forms



ceased, when the Hilo branch was just one mile from the town-house, and the Waiakea branch thirty-six hundred feet from the mill. It had then been flowing a little more than nine months, and had passed over a distance of about forty-five miles.

I arrived in Hilo on the 8th of September, 1881, and immediately visited the flow. This was about three weeks after its cessation, but I found it still very warm. Standing on Halai, a small crater-cone near its lower extremity, nearly its whole length could be traced by the steam arising from it after a shower. I found its surface to be seamed with cracks and fis-

large dome-like masses. The above view gives a very fair idea of this variety of lava. The *a-a*, which forms only a very small portion of this flow, is very rough and jagged, and is almost impassable, being totally so to horses. An adequate description of this peculiar formation is impossible. It must be seen to be appreciated. I have as yet seen no adequate explanation why lava sometimes takes this form. Analyses show the chemical constitution of the two varieties to be about the same. It seems to occur, without any particular reason, at various points on the flow, in areas varying from a few rods to an acre or so. In its pas-



A CATARACT OF RED-HOT LAVA FALLING INTO A POOL OF WATER.

sage through the forest, the flow encountered trees of all sizes, to a yard or more in diameter. Flowing around these, it solidified sufficiently to retain a complete mould of the trunks before they burned off. By means of these upright moulds or wells it is comparatively easy to measure the depth of the lava at any point throughout this portion of its length. This I found to average about twenty feet, though varying very much in particular instances, according to the nature of the surface over which it flowed.

As their trunks burned off, the trees fell upon the surface of the still plastic lava with sufficient force to impress upon it a mould of a portion of their outline.

In both the vertical and horizontal moulds a peculiar impression was made upon the surface of the lava in contact with the tree. It took on a honeycomb structure, presenting a series of indented squares. The cause of this peculiar form I have been unable to determine. The indentations are certainly not the impression of the bark of the trees, and they are altogether too regular to be the result of the expansion of gases.

The general structure of the flow, throughout its entire length, is that of a long, central tunnel with numerous lateral branches. Flowing lava cools very rapidly, — indeed, so quickly, that I have often passed over the surface of that which I had seen flowing fifteen minutes before. Being a good non-conductor, the heat of the inner portions is long retained after the surface is once solidified. In this way a long central tube is formed, from the lower end of which the lava continually flows, while it continually extends the length of the tube. The pressure along the tube is constantly becoming too great for its sides to bear, and lateral off-shoots are formed, increasing the width of the flow. These lateral tunnels usually fill up, and finally become solid. The central tunnel, however, remains hollow throughout a large portion of its length, and may often be traversed for long distances after the flow has become cool. On my first visit to the flow, the top of this central tunnel had fallen through in many places, and I was able to look into it for some distance; but in every case I found the heat still too intense to allow me to descend into it. At later visits this became possible. The roof is commonly rough, a broken surface of lava, but in many cases is smooth and shiny, and covered with numerous stalactitic forms, seldom more than an eighth of an inch in diameter, but often having a length of five and six inches.

The stalagmite form was very rare, and only in one case did I find any of large size. In this instance the lava had flowed over a small precipice in a sheet in such a manner as to leave an opening between the sheet and the face of the precipice. Directly at the foot of the precipice were two peculiar stalagmitic forms made of drippings of lava about a quarter of an inch thick and three and four inches long. The larger of these was about a foot in height; the smaller, not more than half that size. These had evidently been formed by the lava covering a small spring, the steam generated from which had kept the lava above in a semi-plastic condition for some time. These specimens attracted much attention, as nothing of the kind had before been found. They may now be seen in the museum of the Boston society of natural history.

Owing to this peculiar property of lava to form tubes for itself in which to flow, it has the power to flow over small elevations, thus presenting the phenomenon of a liquid flowing up hill. It has the power to continue this till the pressure becomes too great for the strength of the sides of the tube.

The opposite view is from a photograph taken on the spot during the flowing of the lava. It shows the lava in the act of flowing over a precipice about fifteen feet in height. Each of the small streams seen trickling down the face of the rock is red-hot lava. This illustrates the fact that lava flows at the steepest angles, which is sometimes questioned. In this view the lava is flowing into a small pool of water, the resultant steam from which is seen arising like the mist of a cataract. This depression was afterward so entirely covered by the lava, that at my visit the spot could not be distinguished.

It would be interesting, if possible, to give an approximate estimate of the amount of lava which was forced above the surface during this eruption; but with the present data it is impossible. No survey of the flow has been made, and it is exceedingly difficult to estimate its dimensions by the eye. As a very rough estimate, I should place it at something more than five hundred million cubic yards.

GEO. H. BARTON.

THE STATE OF EXPLORATION IN AFRICA.

THE exploration of the dark continent continues with unabated vigor, in spite of the occurrences in the Sudan which nevertheless, in the form of disturbing rumors, must, even at a considerable distance, exercise an evil influence upon the native population.

Humblot, the French naturalist, has been commissioned by his government to investigate the botany and zoölogy of the river-basins of the Kongo, Ogowé, and Gaboon. The Portuguese officers, Capello and Ivens, have been authorized to take up their studies in the same region, and to prepare a chart of the northern part of the province of Angola, belonging to the basin of the Kongo. Lieut. Wissmann is about to return to Central Africa, where Dr. Pogge still remains, and to continue for several years systematic explorations in the Kongo region. A large subscription for the support of the work has been raised in Berlin from scientific and especially from commercial sources, and the results for science and trade will doubtless prove important. His compatriot, Flegel, after exploring the sources of the Benowé, has been directed to proceed in a south-easterly direction, toward the Kongo. For this purpose the German government has reserved a considerable sum of money. He was at last reports about three hundred kilometres from the mouth of the Niger, at Abutchi, near Oniga. The Kongo question continues to form the subject in Europe of a host of pamphlets representing the views of the different parties contending for the control of trade on that great water-way. Most of them seem to carefully avoid touching the real and practical questions now at issue, and devote much space to considerations of a sentimental nature, growing out of matters a century or two old. The day for such reminiscences to have weight in practical politics would seem to have passed.

The French continue the work of establishing better means of communication in upper Senegal, for which the Chambers have recently voted five million francs. Kayes, at the head of navigation on the Senegal River, is now quite a well-constructed, active little town, where two years ago there was little more than a desert. Above this point, only flat boats are available as far as Bafulabé. From this point between one and two hundred kilometres of road, suitable for light two-wheeled vehicles, have been constructed, and fortified posts established at intervals, which are supplied by parties of armed natives, employing in the work more than three thousand pack or draught animals. The part of the railway already constructed is of great use in forwarding material for its extension. Small tramways or horse-railroads have been found of great use in the work of constructing the main line, and ten thousand kilometres of a patented form of tramway have been ordered for this purpose. The object of this at first sight extraordinary project of running a railway into a savage country, beside the protection of the rich colony of Senegal from the devastating incursions of the interior tribes, also includes tapping the Niger at its head waters, and securing the immense traffic of that great river without forcing a way through the pestilential swamps of its miasmatic delta. This is a commercial prize worth a round sum to secure, and in which French courage and enterprise will find an abundant recompense.

From South Africa, Coillard writes that he has reached his old station at Leribé in Basuto-land. Since his previous visit, war has desolated that fine

country, and degenerated into guerilla warfare, by which the traveller suffered greatly on his journey. Later he proposes to strike out into the interior.

From equatorial Africa it is reported that Revoil, leaving important collections to be forwarded to Paris from Mogadoxo, had pushed on to Guéldi. Nothing has been heard from Giraud, who is following a route not in use by caravans; but news is shortly hoped for by way of Kakoma. Capt. Bloyet and his brave wife have arrived at Zanzibar, where he will prepare a report of his last expedition for the French committee of the International African association, and then continue his triangulation in the Usagara region, south-west from Zanzibar. Madam Bloyet has accompanied her husband everywhere, and rendered valuable service, both in his collecting and exploring work. The labors of the missionaries in this region appear to be producing some effect in doing away with the barbarous human sacrifices due to the belief in sorcery, formerly universal. These sorcerers are truly the plague of Africa.

The return of Dr. Fischer terminates one of the most important of recent journeys in Central Africa; and the publication of the results will be awaited with the highest interest. Joseph Thompson, who followed nearly the same route, was last heard from at Wandarobo, having suffered great hardships and many losses from wars waged by the cannibal and ferocious Massai tribe.

Fischer attempted to pass through the Massai country, yet untrodden by the whites, and to reach the reported Lake Baringo. When only six days' march from the object of his journey, he was forced by overwhelming numbers to retrace his footsteps, and pass around Lake Naivasha, where a large hot-spring was found by the Natron Lake near the Doego-ngai volcano, and thence, *via* Angaruka, to Mont Macru. Among other things, two hundred and sixty species of birds were collected.

Dr. Stecker has returned in good health from his explorations in the Galla country, south of Abyssinia, having mapped a large extent of country very carefully and thoroughly.

The usual tribute of noble lives has been demanded by the pestilential climate of Africa. Ernest Marno recently succumbed to fever in the upper Sudan, after having rendered, during fourteen years, distinguished services in the exploration of Central Africa. The unfortunate Dr. Matteucci arrived in London with Massari, from their recent journey across Central Africa, undermined by fever, wrote to his mother that he was about to join her, and in a few hours was no more. Schweinfurth sends an account of the assassination of Sacconi in the Somali country, during his attempt to reach the Wabbi River. He was cut to pieces by five Somalis, under circumstances almost identical with those attending the murder of Mademoiselle Adeline Tinne by the Tuaregs of Fezzan. His servant, who had been charged in such an event to secure the record of the journey, attempted to do so under cover of night, but was surprised, and barely escaped with his life. The record was torn and deliberately burned by a fakir of the tribe.

The unfortunate end of the Marquis Antinori is known. His successor, Count P. Antonelli, more happy, has returned to Rome, and has recently given an account of his investigation of Shoa, in south-eastern Abyssinia, to the Italian geographical society. This society is publishing the results of the Italian expedition. An interesting account of the fresh-water fishes of Shoa has already appeared. Soleillet, the French explorer of Shoa, appears from his reports to be living *en grand seigneur*, under the protection of his Shoa Majesty, King Menelik II., having been appointed to a feudal office somewhat between a baron and a justice of the peace. Bremond's report of his scientific and commercial expedition from the French colony of Obock to Shoa has recently been printed in *L'Exploration*. This region, though but a few years since untrodden by civilized men, offers rich rewards to traders; and the privileges of trade have lately been the object of lively competition between the commercial explorers of several nations. W. H. DALL.

GREEN MOUNTAIN RAILWAY, MOUNT DESERT ISLAND.

THE Green Mountain railway on Mount Desert Island, Me., is intended for pleasure-travel. It was operated for the first time during the last summer season. It is in a great measure a copy of the railway up Mount Washington, New Hampshire, built some thirteen years ago. These two lines, and the Mount Righi railway in Switzerland, are the only ones employing the central cog-rail as a means of surmounting steep gradients. The trip for tourists from Bar Harbor to the summit of Green Mountain is made, first, by wagons or stages, two miles and a half to Eagle Lake; thence by steamer on the lake two miles; and finally by rail sixty-three hundred feet, in which latter distance the ascent is twelve hundred and seventy feet to the summit, fifteen hundred and thirty-five feet above the sea. While the grade averages about a foot rise in four feet and a half distance, in some places it is as steep as one in three.

Surveys were made, and the work of clearing and grading was begun, in the winter of 1882-83. In April a large force of men was employed, and the road was completed by July 1. The track is not raised on trestle-work, as is the case at Mount Washington: much of it, especially on the heaviest grades, is constructed on the solid ledge. Where the longitudinal timbers, or stringers, rest directly upon the rock, iron bolts one and a quarter inches in diameter, six feet apart, are driven through them into holes drilled in the ledge. Where it is necessary to raise the stringers above the surface in order to make a regular inclination, bed-ties are used every six feet, secured against slipping by two or three one and a quarter inch iron bolts firmly fixed in the rear of each tie. All longitudinal timbers required to bring the line to grade are fastened to the bed-ties with iron bolts of the same size. The timbers and ties in contact with the rock were carefully hewed, and fitted to place.

The spruce timber needed for this portion of the work was obtained from a forest-growth on the mountain itself.

The sleepers or ties, six inches square and six feet long, are laid upon the stringers at a distance of two feet from centre to centre, and two seven-eighth inch iron bolts are driven into the stringers, immediately in the rear of each tie, in grooves in the tie, which serve to prevent lateral motion. Upon the ties lie 'T'-rails, joined by fish-plates and bolts, and spiked in the usual way. The rack or cog-rail in the middle of the track is made of two angle-irons which have between them cogs of one and a quarter inch iron accurately rolled to uniform size. This cog-rail is secured to the ties by two lag-screws, five inches and a half long, in every tie, and additional ones at each joint. The rack was manufactured by the Atlantic iron-works, East Boston.

The engine weighs ten tons, and embodies all the improvements suggested by the operation of the White Mountain road. Its entire mechanism is double, — four cylinders, two cog-wheels, and two driving-shafts. Intermediate gearing between the crank-axes and cog-wheels reduces the speed, and increases the tractive force. The cog-wheel axles carry ratchet-wheels with pawls; and either one of these ratchet-wheels, in case of accident to the engine, will hold the train on any grade. In addition, two band-brakes on the smaller shafts may be instantly applied by the engineer. The ascent is made by steam-power; and the engine, when backing down the mountain, is still kept in forward gear, that is, with valves set to go ahead, so that it is constantly pumping air into its boiler; and this air, allowed gradually to escape, exerts an upward tractive force, thus easing the descent.

The floor of the passenger or observation car is adjusted so as to be level on the average grade, and the sides are open to admit of an unobstructed view. The car is always pushed ahead of the engine, and is provided with double hand-brakes, two cog-wheels, ratchet, and pawl, which will easily control the car in descending.

CHARLES E. GREENE.

ANTHROPOLOGICAL PAPERS IN PETERMANN'S MITTHEILUNGEN FOR 1883.

IN order to keep pace with the growth of knowledge respecting the natural history of man, one must not neglect the geographical journals. The files of *Petermann's Mittheilungen* for the past year will be found quite rich, especially in ethnographic information. The following summary will guide to the most important contributions.

Upon the subject of the variation of climate in the region of the southern Mediterranean and northern Sahara, Professor Fischer of Kiel holds, that, in this locality, a diminution of precipitation has taken place, the influence of which on health, population, and the means of living, is easily conjectured (pp. 1-4).

The subject of marshes, *instabilis terra nec navigabilis aqua*, begetter of pestilence, precursor of fertile

fields, and preserver of antiquities, is discussed briefly, in its relation to history and human weal, by inspector T. Schlacht of Oldenburg (pp. 5-12).

The researches of M. Baber in Szetschuen and Yunnan, south-west China, brought him into communication with the Lolos, — an interesting tribe, who present but few points of agreement with the Mongolian type (pp. 26-28).

Dr. Hagen, on a journey inland from the east coast of Deli, in Sumatra, observed carefully the Battas of the coast, the Orang-Lussun of the foot-hills, and the Orang-Karo, Orang-Timor, and Orang-Tobah, in the vicinity of Tobah Lake. The writer dwells at some length upon their anthropometry and their social and technical characteristics (pp. 44-53, 102-104, 142-149, 167-177).

Mr. Fr. v. Schenck has added a little to our information upon the people of Colombia, South America, by references to the Antioqueños and Medellinos (pp. 85-93, 213-220).

A minute description of the inhabitants of the Jagnau valley, which lies near the 40th parallel, on the borders of Turkestan, is given by Bonvalot. These people are considered by Professor Fred. Müller to speak a very old Iranian language (pp. 93-102).

The archeology of Julianehaab, the most southern district of Greenland, first studied by Steenstrup in 1876, has more recently received the attention of Holm, who locates over a hundred ruins of Scandinavian dwellings, and who has examined many graves (pp. 137, 138).

Gerhard Rohlfs rates the number of Jews in Africa at 450,000: to wit, Algiers, 34,000; Egypt, 8,000; Tunis, 60,000; Tripoli, 100,000; Morocco, 200,000; the rest scattered over the continent (p. 211).

The names and localities of the African tribes living on the upper Niger, in Adamaua and the neighboring regions, is given by R. Flegels (p. 246). The accompanying chart is an excellent help in fixing definitely the location of each tribe.

Dr. Emin Bey, governor of the equatorial provinces of Egypt in 1880, made a journey from Lado to Makraka, and in the following year prosecuted his researches through the Mudirié Rohl. Emin Bey's travels were mainly in the country visited by Pethe- rick in 1862, by Schweinfurth in 1869-71, by Wilhelm Junkers in 1877 and 1878, and by Fekin and Wilson in 1879. This communication is illustrated by an excellent map, and contains much that is worth preserving about the tribes along the route (pp. 260-268, 323-340, 415-428). Dr. Junkers has a paper on his travels, in the journal, and describes especially the A-Madi (p. 286) and the A-Baranbo (p. 289) stock. Frequent references to Emin Bey and Junkers will be found in the bibliographic lists of the *Mittheilungen*.

The Rumuni, in Istria, are called by the Germans, Wallachs; by the Slavs, Wlaks; by themselves, Rumuni, or Rumeri. Dr. Karl Lechner devotes a few pages to a description of them (pp. 294-299).

Dr. Polakowsky makes the statement that Mr. Gabb's 'Tribes and languages of Costa Rica' has

been published this year, with learned comments by L. Fernandez, as a special supplement of the Costarican official gazette. The author also describes at length a visit of the Catholic bishop Thiel to the Chirripo, and other tribes of this Central-American state (pp. 300-304).

An excellent example of the application of graphic methods to anthropology is the nationality chart of Bohemia, designed by E. Hochreiter. Among the facts brought out and illustrated is the title which the Bohemians have won for being wanderers. While there are 490,565 Bohemians in Austro-Hungary outside of Bohemia, there are only 80,236 persons in that country who are not natives (pp. 321-323).

St. v. Rogozinski, visiting Liberia in March, 1883, gives a very flattering account of the state of affairs in that colony. Leaving Cape Palmas, he visited the coast of Assini, formerly a French colonial possession, but deserted in 1871. 'Of all the stocks of the west coast,' says Rogozinski, 'that I have seen, the Assinese are the most comely.' The court and village of King Amatifu made a very good impression upon the traveller; and he was able to acquaint himself with many of the customs of the people, especially those connected with the burial of the dead, the taking of meals, fetich doctors, and dancing. The journal of Rogozinski concludes with a brief recital of a visit to Elmina, in Ashanti, and the announcement of his arrival in Fernando Po (pp. 366-373).

Two papers descriptive of the upper streams of the Yang-tse-Kiang and the Taw-la Mountains, by N. Prjevalski, make incidental allusions to ethnologic subjects. The Jegrai and the Golyks (Kolö of Hue), of Tangut stock, find mention on p. 351; and the Tibetans are described at greater length on p. 379.

Notes on the customs of Kafiristan are to be found in the communication relating to that country, by Hughes and Munschi-Synd-Schah, especially on pp. 408, 409.

Supplement No. 71 is devoted entirely to the Cos-sacks. It is compiled from the work of Choroschin and from other sources, by F. v. Stein. We have in this essay an excellent monograph upon the Cos-sacks, commencing with a brief *résumé* of their history, so far as it is known, and enlarging upon their present dispersion, characteristics, their works and industries, and chiefly their social and military organization. Upon the last point, carefully prepared statistics have been compiled.

Supplement No. 72 is a report of Juan Maria Schuver's journey to the upper Nile region, including his observations and discoveries upon the watershed between the Blue and the White Nile, and on the border-line between Egypt and Abyssinia. This number is replete with descriptions of the people in the districts considered.

Supplement No. 73 is a methodical investigation concerning the cinnamon-producing regions, by Dr. Carl Schumann. One of the many useful results of this study is its bearing upon the history of commerce.

*SPENCER'S PHILOSOPHY OF THE
UNKNOWABLE.*

An examination of the philosophy of the unknowable, as expounded by Herbert Spencer. By WILLIAM W. LACY. Philadelphia, Benjamin F. Lacy, 1883. 4+235 p. 8°.

THIS is a work that will interest the student of our American civilization more than the student of philosophy. A man of extraordinary keenness and vigor of thought, plainly a born speculator, but utterly ignorant concerning some of the most elementary matters of physical science, devotes more than two hundred pages of close and ingenious argument to the task of refuting Mr. Spencer's well-known doctrine of the unknowable. The dead horse is flogged with a persistence that astonishes the reader, who has so often, ere this, seen the hopeless task tried without success. For the unknowable is once for all beyond the reach of harm, in the unapproachable regions of the unmeaning; and nothing that we can do or say has any sort of effect on its blessed repose. One might as well hunt snarks as to refute this portion of the Spencerian philosophy. If any refutations had or could have any value for the purpose, we could find enough of them in Mr. Spencer's own writings to content anybody. Quite recently, for example, at the close of an essay on the future of religion, Mr. Spencer has assured us that the 'scientific man' is possessed of an "analysis of knowledge, which, while forcing him to agnosticism, yet continually prompts him to imagine some solution of the great enigma which he knows cannot be solved;" and that this same man, "though suspecting that 'explanation' is a word without meaning when applied to this ultimate reality, yet feels compelled to think there must be an explanation." So that, to turn Mr. Spencer's confession into Saxon, his knowledge makes him feel pretty sure that he is talking nonsense about the unknowable, and yet forces him to keep on talking this nonsense. And this state of soul it is which the doctrine of the unknowable expresses; and the said doctrine is for Mr. Spencer not only very deeply religious, but also the last word of philosophy. Of course, when a man can put all this into print, over his own name, he has really done as much as any living creature can do in the way of refuting his own doctrine of the unknowable; and we can only thank him for his trouble. But surely we are absolved from writing books about this aspect of Mr. Spencer's views, at all events, however much his other views may be worth study or acceptance or refutation. Such passages being

no new thing in Mr. Spencer's books, we therefore look with very languid interest on lengthy refutations like the present one, for we are convinced that some doctrines can well take care of themselves. Moreover, in its form, this refutation belongs to the past age of controversy, the age that culminated in Mill's 'Examination of Sir William Hamilton's philosophy,' — a time of far narrower range in philosophic study than our own, — a time whose problems were fewer and less fruitful, — a time, in short, when to read one or two books, and to show great ingenuity in close logical fighting, might have made any one a match in certain questions for even a great scholar and thinker like Mill. Such discussions we no longer desire. We read more in philosophy, we go to school to more teachers, we think of more problems; or else we have to be content to rank as mere amateurs in philosophy. Our author, like many other students of Spencer in this country, must, for all that we here see, be classed among the amateurs. Philosophy seems to mean to him a very few problems and lines of thought. If it were not so, how could he be content with such a form and range as this for his book? — a mere disputation, close, generally logical in form (save in the portions that touch upon physical science), abstract, dry, ingenious, laborious, but in outcome almost utterly fruitless.

Yet we said that the book ought to interest the student of our American civilization; and so it ought. Here is a man of no small native power, of no small application: he goes to the trouble, and doubtless to the expense, of printing this elaborate disputation of a purely theoretical question; he appeals, and can expect to appeal, only to a few, viz., to the special students of philosophy; he appeals to them with all the quiet assurance of a man who knows what he is about. There is a self-confidence in his manner, but there is no merely pretentious display of knowledge in his book. His style is Spencerian, — Spencerian with a bit more of vigor, and without a bit less of accuracy in form. The work is that of a mature thinker who has considered long and well. Now, however, this man has occasion to talk of the first law of motion. This law puzzles him. If a boy, he tells us, sets a ball going by hitting it with a bat, he himself is quite able to see why the ball is pushed by the bat so long as the bat is in contact with it, but thereafter he is perplexed. Why does the ball keep on moving? "Motion, in the absence of propulsion, is inconceivable;" that is, when the ball ceases to be pushed, it ought

to stop. But since, in fact, it keeps on, there must be a cause for this mysterious behavior. The cause the author thus describes: "Little as is known of the action of air and the ethereal substance, . . . and novel as is the thought of them as continuers of motion, no violence is done to the current understanding of their nature by imagining them as in the act of urging forward an object enveloped in them. The object cannot be made to move without causing much that is before it to move in the same direction, and much also to be dissipated laterally. Thus by opening a path is resistance lessened. . . . Now consider what must simultaneously take place in the rear. A space must be vacated by the object, and as quickly filled up by an in-rushing from all directions except that of the object. To the confluence of forces so formed, there is no outlet except in the direction of the object: consequently this direction they take, impelling the object forward" (pp. 59, 60). Thus it is that the ball moves: the air pushes it. It follows, of course, that no body would follow the first law of motion in a vacuum, and that air not only resists a body's motion, but also helps it to move; and so, in company with the various 'less stable substances' that exist in space, and of which, as we learn, 'there must be many besides heat and light,' the air or some other gas forms the necessary condition for the continuance of any motion. Much more talk of a similar sort follows, about inertia and gravity and like traditional conceptions, for which our author has new explanations, quite as clear and satisfactory as the foregoing.

Now, such passages illustrate the truth that the possibility of Keeley-motor investors also illustrates, a truth painful but indubitable; viz., that high intelligence, coupled with considerable learning, does as yet, in our enlightened land, neither prevent a man from having the wildest notions about the simplest matters of elementary physical science, nor enable him prudently to conceal his ignorance. There are shrewd and educated men to be found, who will invest money in impossible motors; and there are ingenious and not unlearned men to be found, who, like our author, will talk in such confused and ignorant fashion about the simplest matters of science, which ought to have been made clear to them in their school-boy days: yet about other matters they do speak like men of sense. Their defect is not lack of mental power, but simply gross ignorance. Such speech at this time of day is disheartening. But possibly students of science, and more especially teachers of science, may

do well to consider occasionally, in view of such ingenious rubbish as this, what a work they have yet to do, before the public mind is so well trained in elementary conceptions that nonsense like the foregoing shall be not merely nonsense, but impossible to men of our author's intelligence. Good elementary instruction in physical science is certainly very much needed; and here is an illustration of the need, — an extraordinary mind, condemned to seemingly hopeless error on important questions of the most elementary sort, all for the lack of a few hours of sensible teaching in boyhood or since. Meanwhile let the case serve as a warning to those who imagine that our American public is to receive useful instruction in elementary physical science from the now popular works of the great teacher of the evolution-philosophy. Here is a very good student indeed, diligent, logical, and ingenious. What philosopher could hope for a better? He has carefully studied Mr. Spencer's works, and this is what he has got out of them. If, he tells us, an object were pushed into an absolute vacuum with any velocity whatever, we are obliged by the necessities of our thought to suppose that this object "would therefore be stopped by the withdrawal of external influence." Such, Mr. Spencer may notice, is the effect of a use of the 'universal postulate' by a very devout student, who seems to accept so much of the Spencerian system without reserve. The effect of further doses of the 'universal postulate' upon our popular thought in America can only be conjectured. Deliver us from it, merciful powers!

It is only just to add, that Mr. Lacy, while rejecting the doctrine of the unknowable, is not opposed to the philosophic foundation of the positive Spencerian doctrines viewed generally, and finds his objections "not incompatible with estimation of the 'Synthetic philosophy' as perhaps the noblest speculative product of a single mind." We cannot do better than to leave the product and the worshipper in this happy attitude towards each other.

GEOLOGICAL SURVEY OF ALABAMA.

Geological survey of Alabama. Report for the years 1881 and 1882, embracing an account of the agricultural features of the state. By EUGENE ALLEN SMITH, Ph.D., state geologist. Montgomery, W. D. Brown & Co., pr., 1883. 615 p. 8°.

THE law organizing the geological survey of Alabama requires from the state geologist, among other things, a report upon the agricultural resources of the state; and the present

volume has been prepared in obedience to this requirement: it is, in part, based on work undertaken by Dr. Smith in 1880, in the preparation of reports on cotton-culture in Alabama and Florida for the tenth census of the United States. The maps and woodcuts engraved for the census-office, and the statistics collected by the enumerators, were placed at his disposal for this report; while the geological material collected by the state survey during previous years was freely contributed to the census report on Alabama. Subsequently additional work has been done by the state survey for this report; and the resulting volume is most creditable, both to the ability of Dr. Smith, and the wisdom of the state in instituting such a survey.

Part i. of the report is introductory in its character, and consists of a general discussion of the composition, mode of formation, and properties of soils, and of the changes produced by cultivation. This discussion, extending over one hundred and fifty-three pages, is admirable of its kind. It does not attempt to present any original observations; but it is a very full and judicious *résumé* of the present state of knowledge on these topics, and shows a much greater familiarity with them than is usually expected from the geologist.

Part ii., which constitutes the report proper, is an account of the main agricultural features of the state of Alabama. Following the tabulated results of the census enumeration, — viz., table i., area, population, tilled lands, and cotton-production; and table ii., acreage and production of leading crops, — we find section i. devoted to an outline of the physical geography and geology of the state, and an enumeration of its agricultural subdivisions; section ii. giving a detailed description of these agricultural subdivisions; section iii., agricultural descriptions of the counties of Alabama; and section iv., cultural and economic details of cotton-production.

For the purposes of agricultural description, Dr. Smith divides the state into three divisions, — a middle, a northern, and a southern. Of these, the middle division is the oldest geologically, and consists of the south-western termination of the Appalachian chain; and the northern is the next in order, consisting of the southern termination of the great Cumberland tableland and of the highlands of Tennessee, together with the Warrior coal-basin. With the exception of bottom and alluvial lands, the soils of this division are sedentary soils, resting upon the rocks from which they were formed; and both the agricultural and topo-

graphical features of the country are largely determined by its geological structure.

In the southern division, on the contrary, these features are largely independent of geological structure, and “almost exclusively the result of erosion as determined by differences in the material of a single formation, — the stratified drift or Orange sand, which, except in parts of the prairie belt, covers the underlying beds over this whole division.”

The soils of each of these regions are very fully described, the description being in many cases accompanied by chemical analyses and determinations of the more important physical properties. In the middle and northern divisions the classification is chiefly geological, while in the southern it is based mainly on the character of the prevailing forest-growth. A valuable addition to this portion of the report is a list of trees and lesser plants characteristic of the several regions of the state, prepared by Dr. Charles Mohr of Mobile.

The report is illustrated by three geological sections, an agricultural map of the state, and maps showing the distribution of temperature and rainfall for the year, and also for the winter and summer seasons.

LATE ELECTRICAL BOOKS.

Absolute measurements in electricity and magnetism. By ANDREW GRAY. London, Macmillan, 1884. 16+207 p., illustr. 24°.

Notes on electricity and magnetism. By J. B. MURDOCK. New York, Macmillan, 1884. 8+139 p., illustr. 16°.

MR. GRAY'S book on absolute measurements is the outcome of a series of articles from his pen, upon the measurement of currents and potentials, published in *Nature* in 1882 and 1883: it is, in fact, a reprint of these articles, with some alterations and considerable and important additions; and it must be regarded as a most useful contribution to what may be called the *available* literature upon this subject.

The presentation of the systems of computation, based on the so-called absolute units, is clear and accurate, and will enable the student to obtain a firmer grasp upon the methods now all but universally used than can easily be secured from other sources.

The work opens with a description and discussion of methods of determining the horizontal component of the earth's magnetism, upon which so many electrical measurements are made to depend. Mr Gray is a warm advocate of the use of small masses in this operation, suggesting the use of magnets of

steel wire one millimetre in diameter instead of those found in the common form of magnetometer; and in the deflection experiment he uses the light mirror magnets which are found in Thomson's reflecting-galvanometer. In simplicity and convenience, his plan certainly possesses many advantages, as well as in freedom from certain errors which are likely to exist in the use of the more massive forms. It also has the merit of cheapness, enabling any one, at little expense, to determine this important element with a reasonable degree of accuracy. Neither method, however, is free from disadvantages, to which the author directs further attention in a note.

This discussion is followed by a consideration of the methods of calculating the constants of a coil, and the construction of a standard galvanometer, the latter being described with such attention to details as to leave little to be desired. The author then proceeds to explain the use of the standard galvanometer in the graduation of other forms, selecting for this purpose Sir William Thomson's potential and current galvanometers. The construction of these instruments is described, and the process of graduation which is actually adopted in practice. While it is doubtless true that instruments for the measure of current and electromotive force which satisfy all the demands of the practical electrician have not yet been devised, Sir William Thomson's unquestionably rank high among those at present in use. The most serious error which is likely to result from their employment arises out of the change in the strength of field produced by the permanent magnets, which is pretty certain to occur. Mr. Gray suggests several methods of testing the field of the magnets which furnish valuable checks in their use.

Two or three simple tests which are not referred to will readily suggest themselves to any one making use of the instruments.

The discussion of resistance-measurements, although not exhaustive, covers most of the ground; and especial attention is given to methods of measuring very low resistances, now a matter of greater importance than formerly. A chapter is devoted to the measurement of the energy in electric circuits, which includes a valuable discussion of the theory of alternating-machines and methods especially adapted to them.

One of the most interesting features of the book is a description of several simple and ingenious methods of measuring intense magnetic fields, suggested by Sir William Thomson; and also the use of earth-inductors in

absolute measurements, as originally applied by Professor Rowland.

The closing chapter is devoted to a very satisfactory discussion of dimensional equations.

A list of errata accompanies the volume, and several errors not included therein are to be found; but none are of great importance, or likely to mislead the reader; and altogether the book will be welcomed by every student of electricity.

Mr. Murdock's notes are intended to be supplementary to the Elementary lessons in electricity and magnetism by Silvanus P. Thompson, and consist, in the main, of amplifications of some of the propositions in that work, with demonstrations in which a knowledge of the elements of the calculus is assumed. Occasional extensions and additions are also made, which add much to the value of the book. It is likely to be of considerable use to the student of Professor Thompson's elementary lessons, and it may also be used alone with little difficulty. Errors are here and there met with, the most notable of which are to be found in the definitions of units, originating either in gross carelessness, or in a confusion of ideas in the mind of the author. The distinction between work and rate of work, or *activity* as it is happily named by Sir William Thomson, is not regarded in the definitions. A coulomb is defined as an ampère per second. A watt, which is activity, is defined as 10^7 ergs, which is work. The watt and joule are declared identical; although the first is activity, and the second is energy. The joule is defined as a quantity of heat: the suggestion of Sir W. Siemens was, that it should be a unit of work, equal to 10^7 ergs.

Thanks to the efforts of the British association and the international electrical congress, the nomenclature of electrical measurement is well-nigh perfect; and it is both important and easy for the student to acquire in the beginning clear and accurate conceptions of the nature and relations of the units involved. Is there not, however, a tendency at the present time to overdo the matter of creating and naming units? Too many will complicate rather than simplify processes of computation. The use of 'joule' does not seem to be altogether free from criticism, on account of the fact that the same name, or at least the initial *J*, has long been in use as the symbol for the mechanical equivalent of heat. There does not appear to be any good reason for making a unit of the current which will evolve one cubic centimetre of mixed gases per minute, and

calling it a 'jacobi,' as all derived units should be related to the fundamental units of length, mass, and time, through simple, decimal ratios.

There is danger, in fact, of the simple ele-

gance of the absolute system being destroyed by excessive ornamentation; and it is well enough to make haste slowly in adding to what has already been done.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Paleontology. — Prof. H. S. Williams, from his preliminary study of the specimens he collected during last season in Genesee and Wyoming counties, N.Y., from the Genesee slate and Portage formations, reaches some interesting conclusions. He is convinced that the black shales which appear in the lower Portage of this region, and continue to appear as thin zones up to a point just below the Portage sandstones, represent merely an interrupted continuation of the deposits called the Genesee slates. After the typical Genesee slate was deposited to some considerable thickness, the Portage fauna made its appearance in the soft, blue, argillaceous shales. A hundred feet higher another black shale appears of several feet thickness, and then olive shales come in; and for several hundred feet this alternation continues, the black shales becoming thinner with each repetition, and containing an increasing amount of impurity, siliceous and argillaceous, so that in the upper part there are only dark-gray bands or streaks of the olive shales, with fine paper-like layers of black. The earlier Portage black slates bear the same fauna as the Genesee, but the specimens are fewer. Although these black slates are interstratified with the olive shales, they do not contain the Portage fauna. It is confined to the olive layers, and, higher up, to the bluish argillaceous shales. Near the top of the Portage series the sandstones come in. They are of a light-gray color, and are generally calcareous. They frequently have a petroleum-like odor. With them the Chemung fauna is associated. The lowest observed appearance of that fauna was in Java township, Wyoming county, in the first of the gray sands lying just above the last-observed black zone, which was bituminous.

Professor Williams also says that some interesting features have been revealed by the study of a large series of specimens of *Spirifera mesocostalis* Hall. In the representatives of the species from the upper Devonian, there is a well-developed median septum in the ventral valve, as in the genus *Spiriferina*; but the punctate character of the shell of that genus has not been observed in any of the specimens. The lower forms, at its first appearance in the Ithaca group, very rarely show any trace of the septum. As far as Professor Williams's examination has gone, he finds that the median septum is more fully developed and more generally present, the higher up the specimens are found. In harmony with this observation is the reference, by Mr. Whitfield, of a similar specimen from

Wisconsin (Geol. Wisconsin, iv. 332) to *Spiriferina* under the name of *Spiriferina* (?) *ziczac*.

STATE INSTITUTIONS.

New-York state survey.

Rainfall of western New York. — To ascertain how much water is likely in different seasons to flow off of the surrounding watershed into Oak-Orchard Swamp, it was necessary to study with great care the rainfall of the western part of the state for the past fifty years. A careful analysis was therefore made of observations taken at Rochester university since 1830, and by the U. S. signal-service at Buffalo and Rochester since 1870. The result of this discussion of the Rochester rainfall is quite remarkable. It is shown, that from 1830 to 1880, during the very period when the woods were being cut off from the western part of the state, the rainfall steadily increased from a mean annual precipitation of 27.7 inches to 38 inches. The average was 34 inches. From 1868 to 1881 inclusive, there was the greatest average rainfall known for a similar period in that locality: it was 38.73 inches. The greatest recorded monthly, daily, and spring rainfalls occurred between 1870 and 1880. This decennial period is therefore a safe one from which to estimate maximum amounts of water likely to be discharged from watersheds in the western parts of the state; but towns whose future water-supply is estimated from the amounts received into lakes or streams since 1868 may find themselves very short of water, if the mean annual precipitation should decrease to that of the period from 1830 to 1840. Long periods of small average rainfall will doubtless recur in the region near Lake Ontario. The city of Rochester should be prepared for a time when, for ten years, the average yield of water from its present source of supply, the basin of Hemlock Lake, may amount to only three-quarters of the average flow from 1868 to 1881.

Quantity of water evaporated from various watersheds. — While the mean rainfall of this region has increased during the past fifty years, the summer flow of the streams has greatly diminished. This is due partly to the loss of retaining-power in the ground, owing to the removal of the soft forest mould, which in former times readily absorbed the rain and melting snows, and so prevented these invaluable waters from rushing off and wasting themselves in destructive floods, and partly to the enormous increase in evaporation. The proportion of rainfall, which, owing to evaporation, is lost for use in springs, lakes, and streams, is known to but few. In the special

report will be found a collection of observations on evaporation in this country and Europe. They show that large rivers receive in the main channels seldom more than one quarter of the average amount that falls on their watersheds. The remaining three quarters is evaporated. On small watersheds the proportion of loss from evaporation is small. The average flow into Croton Lake is about fifty per cent of the average rainfall on the gathering-ground, the area of which is 339 square miles.

The amount of water flowing from Cochituate Lake watershed, of 18.75 square miles, is, on the average, forty-five per cent of that which falls; but the proportion varies greatly from year to year. In 1866 only twenty-five per cent of the rainfall flowed into the lake; while in 1857, with almost the same rainfall, seventy-four per cent of the precipitation entered the lake. The difference in the amount evaporated in 1866 over that of 1857 was equivalent to a depth of thirty inches of water over the whole gathering-ground. Experiments made in Denmark and England show that the mean annual evaporation from soil and grass land is from twenty-six to thirty inches, or from fifty-six to sixty-seven per cent of the rainfall. The tables of rainfall and flow of the Sudbury River and Cochituate Lake show, also, that the summer evaporation amounts to eighty per cent of the rainfall on these basins; and that in March and April all the rainfall may flow off, together with a large amount of water from melting snow accumulated during the winter. The Sudbury River tables show that on this watershed the loss of water by evaporation between May and December is from three to four times the quantity lost in spring floods.

Effect of woods on the flow of streams.—The facts given prove that evaporation from the ground is the most effective cause controlling the summer and autumn flow in our streams: therefore whatever tends to retard evaporation will increase the summer flow of springs and streams. The great promoters of evaporation are heat, dryness of atmosphere, and wind. Woods, especially when the trees are large, act in three ways to prevent evaporation from the ground: they keep the surface cool, the atmosphere moist, and the lower stratum of air so still that the powerful drying-action of the winds is felt comparatively little. The amount of water which will be lost from any watershed by the removal of the woods must depend on the steepness of its slopes, the character and depth of soil, and the nature of the underlying rocks.

The greater part of the basin of the west branch of the Croton River is wooded. Its area is about twenty square miles. It yielded for four years an average flow of sixty-three per cent of the rainfall. The mean precipitation was 50 inches. The yearly evaporation was as follows: 15 inches, 11 inches, 23.6 inches, 15 inches. The Sudbury River basin in Massachusetts, containing seventy-eight square miles, is wooded over only from one-sixth to one-eighth of its area. From 1875 to 1879 inclusive, the mean annual rainfall was 47.7 inches, and the amounts of water

lost, principally by evaporation, were 25 inches, 26 inches, 19 inches, 27 inches, 23 inches. The Cochituate basin is only partially wooded. Its average rainfall, 50 inches, is about the same as the West Croton and the Sudbury. The average yearly loss from the watershed is 27 inches, while in certain cases the evaporation alone must have exceeded 35 inches. The West Croton appears to yield in its flow some eighteen per cent more of the rainfall than the other watersheds mentioned; but the dissimilarity in their topography and geology makes it impossible to say how large a part the woods play in the differences of flow. Yet the result bears out the ordinary rule deduced from observations taken in Europe, that the average flow in streams draining wooded and swampy basins will be from sixty to eighty per cent of the mean rainfall, while those draining watersheds of undulating pasture and woodland generally receive into the main channel only from fifty to seventy per cent of the mean rainfall. Should the rule prove applicable in this country, the average increase of evaporation by the removal of woods from a district may amount to ten per cent of the annual rainfall. This loss will occur mainly in summer and autumn, so that the flow during this season will be diminished in far greater ratio.

With almost equal rainfalls (22.5 and 20 inches), more than two and a half times as much water (8.3 inches) flows from the wooded basin of the West Croton as is discharged from the comparatively unwooded watershed of the Sudbury River (2.9 inches) between June 1 and Nov. 1. During the remainder of the year the discharge from these two watersheds is almost the same. These results, being deduced from only four years of observation, would be modified by further measurement. The great difference in the flow from these two basins, since it is shown to occur between June and October, is undoubtedly due to a difference in the amount of water evaporated; and this is only partly accounted for by differences of topography and soil. The woods are surely playing an important part in maintaining the summer flow of the West Croton. Cutting them off might easily reduce the summer and autumn flow twenty-five per cent. While it must be understood that the facts are too limited to base any final results upon them, yet they indicate the probability that the summer and autumn flow of streams may be reduced in volume twenty-five per cent by cutting off the woods from their watersheds. If the summer and autumn flows in the upper Hudson, the Mohawk, and the Black Rivers, were lessened twenty-five per cent from their present average volume, the navigation of the Hudson and the canal would be doubtful; and certainly the loss in hydraulic power for manufacturing-purposes would be very great. While the people of New-York City are wisely taking an active interest in the protection of the northern forest, they should not forget that the preservation of the woods on the Croton watershed is of great importance in maintaining the summer water-supply of New York.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

March 11. — Professor Thomas Meehan made a communication upon a root said to be that of *Conium maculatum*, which was so virulently poisonous as to have quickly caused the death of a number of children who had eaten of it. In consequence of the rarity of *Conium* in the neighborhood, he was inclined to believe the species to be *Cicutum maculatum*, a common local plant, the root of which resembles that of *Conium*, but is not so dense. He proposed planting the roots with a view to making a further report on the subject when the leaves are sufficiently developed to place the specific characters beyond question. — Mr. Edward Potts stated that the stems of *Urnatella gracilis* on the dry sponge-crusts recently collected had germinated after being placed in a life-case, showing that life persists in the stems during the winter, and makes itself manifest in the spring. He had found it somewhat difficult to work out the complete life-history of the polyp, in consequence of its being the prey of several associated forms of life. — In a paper on the rufous or thatching ant of Dakota and Colorado, the Rev. Dr. H. C. McCook recorded the finding of the hills made by the species on the entire rolling prairie lying between the Cheyenne and the James Rivers. Specimens of the insect had also been sent to him from Iowa Gulch, near Leadville, taken from an elevation of 11,300 feet above the level of the sea. In its power to resist the vigor of the winter at high elevations, the American form resembles the *Formica rufa* of Switzerland, which is found as far up the Alps as the line of vegetation, farther progress being apparently limited by the lack of vegetable growth rather than by the cold. They may therefore be reckoned, both on this continent and in Europe, as among the most hardy of the ant-fauna, and best adapted to contend with severities of cold. Their hills in Dakota are, for the most part, conical elevations somewhat flattened at the top. Some present the peculiarity of a square base, giving the hill the appearance of a pyramid with a rounded top. Their height ranges from eight inches to a foot and a half. The largest mound observed was found near the summit of the Ute Pass. It was a conical heap, four feet long, and about one foot high, and looked like a small hay-stack, in consequence of its being covered or thatched, in common with all the others about Leadville and in Dakota, with bits of wood and broken sprigs of pine. As the colony increases its numbers, and the necessities of internal domestic economy require the enlargement of the fornicaries, the excavated soil is brought up and laid on the thatching. In course of time a new roof of chips and clipped grass is overlaid; and thus, in the ordinary growth of a mound, there would be an alternation of earth and vegetable substance. The marriage-flight of the species takes place in the spring, with the first appearance of vegetation; and the swarms are a source of annoyance to the workers in the fields, although they do not get angry and rush at parties,

attacking them, as bees do. The annoyance produced by such swarms is more than compensated for by a curious insectivorous habit of the ants, of which the settlers avail themselves to rid their clothing of lice. Garments so infected, left in the vicinity of the fornicaries, are quickly and perfectly cleaned of both parasites and eggs, — a fact which was formerly well known to the Indians of the plains and to old pioneers and campers.

Natural science association, Staten Island.

March 3. — Mr. Seehusen read a paper upon gems, giving a description and history of the principal stones used as gems, with specimens to illustrate the notes. — Mr. Leng read a paper upon the Coccinellidae of Staten Island, of which he recorded eleven species. — Mr. Hollick remarked, that numerous specimens of the common seal (*Phoca concolor*) had visited the shores of Staten Island during the past month. If not disturbed, they would, no doubt, again return to the locality, and remain permanently with us, as do the sea-lions on the 'seal rocks' of San Francisco harbor, where they are protected by law. The speaker also remarked, that a single specimen of the great northern diver (*Colymbus torquatus*) had been noted in the bay, not far from the Staten Island shore.

Biological society, Washington.

March 8. — Dr. J. H. Kidder, U.S.N., exhibited specimens of *Bacillus tuberculosis*, and summarized the existing state of knowledge and opinions concerning its relation to tuberculosis. Dr. D. E. Salmon called attention to the claims of Toussaint as the discoverer of *Micrococcus* in tuberculosis, and remarked that the relation of Koch's *B. tuberculosis* to the disease is not yet certainly ascertained to be more essential than that of *Micrococcus*. — Dr. D. E. Salmon exhibited specimens of infectious tuberculosis from cattle, in which he had been able to discover no traces of bacillus. — Mr. C. W. Smiley read a paper on what fish-culture has first to accomplish. Fish-culture, he remarked, cannot be expected to perform what is impossible; namely, to fill the waters of a continent to overflowing with an inexhaustible supply of fish: on the contrary, it will have to put forth the utmost effort to prevent the entire annihilation of the fish-supply through the uncontrollable activity of the fishermen. — Col. Marshall McDonald read a paper on the influence of temperature upon the movements of fish in rivers, in which the fluctuations of the catch of shad in the Potomac in 1881-83 were explained by reference to the varying temperature of the waters of ocean, bay, and river, at the time of their anadromous movements.

March 22. — Col. Marshall McDonald exhibited a chart showing the natural and restricted river-distribution of the shad. — Dr. R. W. Shufeldt, U.S.A., offered some remarks on the patella, describing the position of this bone, which he considered to be a true sesamoid in various forms of mammals and

birds. — Mr. Romyn Hitchcock exhibited a series of specimens of Orbitolites, and made some remarks upon the results of the work of Dr. William B. Carpenter as finally set forth in vol. vii. of the report of H. M. S. Challenger. — Prof. C. V. Riley presented some personal reminiscences of the late Dr. George Engelmann, which were supplemented by remarks from Dr. George Vasey and Professor Lester F. Ward. — Mr. Richard Rathbun exhibited a large mass of coral (*Oculina*, sp.) recently obtained from Key West, growing on the end of a crowbar, which, when further studied, would probably yield some clew to the rate of growth of the species. — Mr. M. G. Ellzey spoke on the prepotency of the male parent, giving the results of twenty-five years' experience in breeding horses, dogs, and other kinds of live-stock. The male parent he believes to be prepotent in the transmission of hereditary traits, except where some extraordinary circumstance intervened. In the case of hybrids between the horse and the ass, a cross is always marked by prepotency of the ass; and in all crosses of two species the male is always prepotent. Mr. Dall called attention to the danger of drawing conclusions from observations upon the external characters of the products of the union of two species. — Dr. Leonard Stejneger exhibited two magnificently mounted specimens of the great Kamtchatkan sea-eagle, *Thalassæetus leucopterus*; also a specimen of the bald eagle, *Haliaeetus leucocephalus*, and a specimen in immature plumage of another species, probably undescribed, and probably in the adult state entirely white. The rivers of Kamtchatka abound greatly in salmon, and eagles are in consequence particularly numerous.

Mathematical section, Philosophical society, Washington.

Feb. 20. — Mr. H. Farquhar showed the application of two kinds of empirical formulae to observations of the diminution of amplitude of a freely oscillating pendulum at different atmospheric pressures. When the amplitude and the time were connected by the equation of a hyperbola with four constants (the term involving the amplitude square being omitted), the observations could always be perfectly satisfied. The chief advantage of this form, however, was the ease with which the constants could be calculated from the observations by least squares. A formula more convenient in practical application gave for the time a constant, divided by the n th power of the amplitude; where n was a fraction proportional to the square root of the atmospheric pressure, and equal to about one-third for a pressure of thirty inches. The initial time, or time of an infinite amplitude, was a third constant to be determined; and it should be determined separately for all intervals within which the correction for amplitude is desired. Great nicety in the calculation of n was not necessary: the nearest tenth, or reciprocal, of a whole number, would suffice. The accuracy of this formula was shown by tables to be quite as close as the observations called for. When n became zero, the n th power was replaced by the logarithm of the amplitude, and the initial time was that of am-

plitude unity. The use of an empirical formula, of higher practical convenience than those usually adopted, — resulting from application of the theory that the diminution results from two resistances, proportional respectively to the velocity (or amplitude) and to its square, — was defended on the ground that this theory is itself empirical, and is well known to fail altogether for very high velocities. The proposed formula supposed in effect one resistance proportional to the $1 + n$ power of the velocity of the pendulum.

NOTES AND NEWS.

FROM *Nature* we learn that Sir Joseph Hooker has been nominated one of the vice-presidents for the Montreal meeting of the British association. Instead of Mr. Crookes, Prof. W. G. Adams will give one of the public lectures. For the Aberdeen meeting in 1885, Sir Lyon Playfair will be proposed as president. A well-attended meeting of the organizing committee of the chemical section has been held under the presidency of Professor Roscoe. Promises of papers were received from several well-known chemists, and a small executive committee was formed to draw up a list of papers, and to communicate with Canadian and American chemists. Section G has been particularly active. The committee has prepared a list of subjects for papers which it is thought would be interesting to English visitors if treated by engineers and mechanicians in Canada: a good supply of papers is expected, both from this country and America. Sir J. H. Lefroy has accepted the presidency of the geographical section. We regret to learn that Professor Williamson, the general treasurer, will be unable to be present; and the council have decided to engage the services of Mr. Hamy Brown as 'financial officer,' while Professor Burdon Sanderson has virtually consented to act as deputy for the treasurer at Montreal.

— The last number of the *Harvard university bulletin* contains further instalments of Mr. Winsor's bibliography of Ptolemy's geography and the Kohl collection of early maps; the former containing some very interesting comments on the knowledge of America about the middle of the sixteenth century, the latter relating exclusively to maps of the new world issued in the first half of the same century. Mr. Bliss's classed index to the maps in *Petermann's mittheilungen* will be completed in the next issue, and we may expect its separate publication in a few weeks. It will prove a great convenience.

— At the request of the navy department, the fish-commission steamer *Albatross*, Capt. Tanner commanding, was fitted out during the winter for the purpose of carrying on a series of deep-sea soundings and dredgings in the Caribbean Sea, a region very little known in respect to its depths. The vessel left Washington Jan. 1, and reached St. Thomas on the 17th, and, after coaling, proceeded on her voyage, making the following ports: Curaçoa, Trinidad, the Island of Oruba, Alta Vela, Jacmel, Gonaives, Santiago de Cuba, Navaza, and Kings-

ton (Jamaica), where she arrived March 1. She left Kingston March 11, and arrived at Aspinwall, *viâ* Savanilla, March 25. On her return from Aspinwall she will proceed *viâ* Cape San Antonio to Key West, expecting to arrive at the Washington navy-yard about the middle of May. The expedition has been a great success in all respects; numerous satisfactory series of soundings and temperatures having been taken, and large numbers of marine animals obtained. In the collections incidentally obtained during the stop of the steamer at Trinidad were two specimens of the guacharo-bird, *Steatornis caripensis*, which is such a rarity in museums, and two of the great fishing-bat.

—The botanical collection of the late Charles F. Parker of the Philadelphia academy of sciences has been purchased for the Princeton herbarium. It is remarkably good as to the New Jersey flora.

—The report of the U. S. solar-eclipse expedition has just been ordered to be printed by Congress. Among its contents are, meteorology of Caroline Island, by Mr. Winslow Upton; botany of Caroline Island, collections by Dr. W. S. Dixon, U.S.N., and identifications by Prof. W. Trelease; notes on the zoölogy of Caroline Island, by Dr. W. S. Dixon, U.S.N.; memorandum on the butterflies, etc., of Caroline Island, collections by Dr. J. Palisa, identifications by Messrs. Herman Strecker and Arthur G. Butler; chemical constituents of the sea-water of the lagoon of Caroline Island, determined by Messrs. Stillwell and Gladding; observations of twenty-three new double stars, by Prof. E. S. Holden and Prof. C. S. Hastings; plans for work on the day of the eclipse, by Prof. E. S. Holden; reports on the eclipse; report in regard to the photographic observations of the eclipse, by Mr. H. A. Lawrance.

—Twenty-three years ago Mr. W. Nelson was in the habit of collecting fresh-water shells in a small pond near the Black Hills, Leeds. At that time only four forms were to be found there,—*Sphaerium lacustre*, *Pisidium pusillum*, *Planorbis nautilus*, and *Limnaea peregra*. After thirteen years an additional species, *Planorbis corneus*, made its appearance. These were the only species found there until the spring of 1883, when, to the surprise of the collector, six species previously unknown there made their appearance successively. This remarkable increase, which is well attested, took place without any apparent change in external conditions at the locality mentioned.

—After solving most of the knotty problems of molecular physics, the Rev. Dr. J. G. Macvicar departed this life, Feb. 12, from Moffat, Eng., aged eighty-three. He is reputed to have had some influence with Smithson in persuading him to establish the Smithsonian institution, and seems to have been much respected among his parishioners.

—An instance of the practical application of science to every-day life is well shown in the building of the capitol building of Dakota, at Bismarck, by the aid of electric light. This building, costing a quarter of a million of dollars, consists of three stories, base-

ment, and sub-basement, measuring a hundred and fifty-five feet by ninety-two feet, and contains over four million bricks, with trimmings of Joliet stone, and has been erected in the midst of winter. The corner-stone was laid Sept. 5, 1883; and on the 10th of January, 1884, a few days more than four months later, a photograph shows the building to lack only the projection of one side and the upper part of the tower. This result was accomplished by the employment of electric light, which half the time replaced the sun, enabling double gangs of men to work day and night. The frozen sand was thawed by a red-hot cylinder; and the mortar, made with boiling water and hot lime, had its moisture absorbed by the dry bricks before it had time to freeze. Although taller, the building is an almost exact duplicate of the new capitol of Minnesota.

—The *Journal of the Society of arts* states that the coal-measures of New South Wales embrace an area of about 23,950 square miles. The seams worked vary from three feet to twenty-five feet in thickness, are nearly horizontal, and are in some localities considerably above sea-level. There are at the present time forty-one collieries at work, employing in the aggregate, above and below ground, 4,125 miners and others. In addition to the foregoing, there are two mines at which very valuable seams of petroleum-oil, cannel-coal, or kerosene shale are being worked. The number of men employed at these mines above and below ground is two hundred and thirty-one. Since 1865, when the working of these seams commenced, the output has been 241,284 tons, valued at £581,046. There are three principal coal-mining districts,—the Hunter River and Newcastle coal-field, situated to the north of Sydney; the Southern or Illawarra coal-field; and the Western or Lithgow coal-field, upon the Great western railway line, about ninety-five miles west from the metropolis. Coal is also being worked near Berrima, between Illawarra and Lithgow; and some seams are known to occur in the country lying between Lithgow and the Hunter River. Sydney, therefore, occupies an almost central position with regard to the coal-mining districts; and beyond these, coal has been discovered in different parts of the colony.

—Director Wild of St. Petersburg, as president of the International polar commission, has sent out invitations for the congress of arctic travellers in Vienna on April 22. The members of the expeditions sent out in August, 1882, by all the great states north of the equator, to make simultaneous observations of meteorological and magnetic phenomena, are expected to attend.

—Dr. George A. Groff has published a fifth revised edition of his 'Book of plant-descriptions, or Record of plant-analyses,' through the Science and health publishing company. It consists principally of a number of blanks to be used in the analysis of flowering plants, and for this purpose may be useful to teachers of small classes who do not wish to go to the expense of having blanks printed. There is also a list of terms used in descriptive botany, not, however,

accompanied by definitions. There is also a list of subjects suitable for theses, — rather an extraordinary array, on the whole, and requiring in a number of cases a much more elaborate equipment than that recommended on a previous page. The tabular view of the vegetable kingdom would better have been omitted altogether, as it is antiquated and faulty in several respects: desmids and diatoms are protophytes, and what coccoliths may be we are unable to say.

— Under the auspices of the Paris geographical society, a course of lectures is being given on the following subjects: Mr. Faye, The connection of astronomy and geography at the principal periods of history; Mr. de Lapparent, Reliefs of the globe; Mr. E. Fuchs, Distribution of minerals; Mr. Mascart, director of the weather-bureau, Climate; Mr. Velain, Glaciers, and their action on the reliefs of the globe; Mr. Bureau, Geographical distribution of plants; Mr. Ed. Perrier, The depths of the sea, and their inhabitants; Mr. Alphonse Milne-Edwards, Geographical distribution of animals. The first was given Feb. 11, and the last is put down for March 31. The course will be continued next year.

— From observations of the weather of the past seventeen winters, taken at Lawrence, Kan., by Prof. F. H. Snow, it appears, that, during this period, five winters have had a lower mean temperature and a larger number of zero days than the winter just closed, six winters have had a larger number of winter days, but only one has had a lower minimum temperature. The rainfall (including melted snow) of the past winter has been three-fourths the average amount; the fall of snow has been slightly above the average depth; the cloudiness has been more than two per cent above the mean; the wind has exceeded its average by more than five thousand miles; there has been a single thunder-shower (the average number); there has been one more fog than usual; and the barometer has exceeded its average height.

— Dr. C. V. Riley, of the Agricultural department of Washington, states that the rust which is often seen on oranges, and which decreases their market value by about a dollar a crate, is produced by a mite. He finds that this mite is very susceptible to sulphur and kerosene and milk, which, if judiciously applied early in the season, will preserve the brightness of the fruit.

— Mr. Francis Speir, whose address is South Orange, N.J., has sent out a circular, asking for replies to eleven sets of psychological questions, whose aim is "to cover the field of conscious mental activity in its relations with a possible unconscious cerebral activity." He desires to collect facts of personal experience from those who answer the circular, and to use these facts for the purposes of a classification and co-ordination of the phenomena.

The questions seem to us of very unequal value and definiteness. When Mr. Speir asks, "What is the greatest number of distinct ideas you can consciously have before your mind at one time?" he asks a question that seems to us hopelessly vague. Wundt has tried to give such a question a definite meaning, and

to investigate it systematically. Even his results seem to us somewhat ambiguous. For the ordinary observer of subjective states, the question may mean almost any thing or nothing; for what ideas shall he call distinct? and what is one time? Still, Mr. Speir may get some intelligible answers to this inquiry; but, as we venture to say, they will not all really refer to the same question. The question, "Can you wake precisely at a given hour determined upon before going to sleep?" is an example of a definite and fair question. But to ask of people in general, "Have you ever dreamed a dream precisely like one your parents or ancestors have dreamed?" seems to us to invite mere idle gossip. The answers, if negative, interest nobody: if they are affirmative, they might interest a collector of folk-lore; for, in telling his dream-experiences, who is very accurate at the best? In remembering and repeating them over and over, who is free from the manifold errors of memory? But in comparing one's own dreams with the traditions of the dreams of one's grandmother, who will be able to give answers that can be called scientific? The more confident the reply, the less useful, in such a case, the supposed fact. There is a whole folk-lore of family traditions, as yet little known to science, because it is the private amusement of the fireside. Let us leave it all, for the present, to the poets, to the story-tellers, and to our aged female relatives. There are psychical facts nearer to observation, and less subject to whimsical, incalculable sources of error.

We suggest these criticisms because this work of collecting facts by means of psychological circulars is yet in its infancy, and its very life is threatened by any injudicious use of it. Mr. Speir's questions are, in the most of these cases, very fair; but the few injudicious ones endanger the success of his work. Plainly, in asking questions about subjective states, we are in perpetual danger of bad observations as the basis for the answers that we get. What are our safeguards? Plainly, as Mr. Galton's success has shown us, the necessary safeguards are, to ask only perfectly definite questions, to ask questions in whose answer our subject has no disturbing personal interest, and to be careful not to ask questions that popular tradition has already answered by some poetical or otherwise interesting myth. Best of all are the questions whose answer our subject will never before have thought of at all, so that he will have no theory of his own. Unless we take some such care as this, our latest effort at the collection of psychological facts will degenerate into the most tedious of disastrous wanderings. We await with interest Mr. Speir's paper on the results of his inquiry, for most of his circular is promising enough.

— The following singular advertisement appears in the *Deutsch-Kroner zeitung* of Dec. 11: "Magpies shot between Dec. 24 and Jan. 6 are used for a remedy against epilepsy. The undersigned, with whom this medicine is prepared, will be greatly obliged to every one who will send him at that time as many magpies as possible, provided that they have been shot, and not killed by poison or caught in traps. — Castle Tütz, Dec. 5, 1883. Signed: Theodor, Count Stolberg."